RUARY, 1959

ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

SPACE AGE ADHESIVES—*An Analysis of Current Requirements* **20**

LAMINATING WOOD STRUCTURAL MEMBERS—*New Adhesives Ease Production* **26**

ADHERING DACRON TO RUBBER—*Blocked Isocyanates In An Aqueous Media* **30**

BOOKBINDING AT THE UN—*Simplified Techniques Speed Mass Output* **38**

Why users prefer neoprene adhesives for so many different surfaces

Metals, non-metallics, leather, wood, rubber, fabric—manufacturers are successfully bonding these and many other surfaces with quality adhesives based on Du Pont neoprene synthetic rubber. Here are some of their reasons:

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Neoprene is backed by 25 years of proven performance as an industrial and automotive adhesive. Special neoprene adhesives are now used by manufacturers of shoes, aircraft, furniture and building materials. Ask your supplier about neoprene adhesives or write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. (AA-2), Wilmington 98, Delaware.

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BAKELITE TO NEOPRENE	FABRIC TO WOOD	GLASS TO PAPER	METAL TO METAL
BAKELITE TO RUBBER	FORMICA TO PLYWOOD	GLASS TO PLASTICS	METAL TO PLASTICS
CONCRETE TO RUBBER	GLASS TO BAKELITE	GLASS TO RUBBER	METAL TO RUBBER
FABRIC TO FABRIC	GLASS TO CERAMICS	GLASS TO WOOD	METAL TO WOOD
FABRIC TO METAL	GLASS TO FABRIC	LEATHER TO LEATHER	NEOPRENE TO NEOPRENE
FABRIC TO PAPER	GLASS TO FORMICA	LEATHER TO METAL	RUBBER TO RUBBER
FABRIC TO PLASTICS	GLASS TO GLASS	LEATHER TO RUBBER	RUBBER TO CERAMICS

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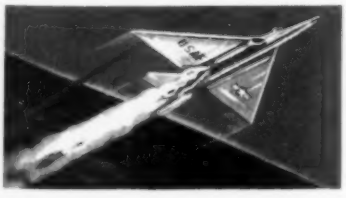

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HT-4	−65° to 500°F Continuous plus 1750°F Intermittent	Putty
HT-5	−80° to 600°F Continuous plus 2500°F Intermittent	Paste
HT-12	−65° to 300°F Continuous plus 1500°F Intermittent	Heavy dough-like
HT-13	−65° to 350°F Continuous plus 2800°F Intermittent	Heavy dough-like
HT-23	−60° to 350°F Continuous plus 1800°F Intermittent	Heavy dough-like

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An Air Force Thor (Intermediate Range Ballistic Missile), under development by the Air Force and the Douglas Aircraft Co., is typical of space vehicles requiring new and complex adhesives. Official photograph courtesy of the U.S. Air Force.

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PALMERTON PUBLISHING CO., INC.

FEBRUARY, 1959

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10,600 Copies of This Issue Printed

ADHESIVES AGE is published monthly by the Palmerton Publishing Co., Inc. Printing Office, Bristol, Conn. Editorial and Advertising Offices at 101 West 31st Street, New York 1, N.Y. Subscription in the United States, $5.00 a year; Canada, $5.50; Foreign $6.00. February, 1959. Volume 2, Number 2.

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- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Adhesive Bonding for Fibrous Glass Reinforced Plastics—H. A. Perry. $8.75.** A theoretical and practical manual on the joining of glass reinforced plastics. ☐

- **Adhesives for Wood—R. A. G. Knight. $5.00.** A guide and reference to the problem of joining components together. Considers components made of wood in one of its many forms and the joining of wood to metals and plastics. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice —A. X. Schmidt and C. A. Marlies. $12.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives; their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research —G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Rubber-to-Metal Bonding—S. Buchan. $4.00.** Discusses methods for bonding natural and synthetic rubbers to metals of all kinds, for use by those who manufacture rubber-metal units, and of interest to the rubber-minded engineer. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Adhesion and Adhesives: Fundamentals and Practice—F. Clark, J. E. Rutzler, Jr. and R. L. Savage (Editors). $10.50.** Papers read at a Symposium at Case Institute of Technology and a Conference in London, on the status of knowledge in adhesion. ☐

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Published Monthly by
PALMERTON PUBLISHING CO., INC.
Editorial and Advertising Offices
101 West 31st St., New York 1, N. Y.
Phone: PEnnsylvania 6-6872

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EDITORIAL

Test Tubes and Profits

An interesting point relative to the soaring cost of research in the chemical industry was raised by L. G. Bliss, president of the Foote Mineral Co., in an address before the recent meeting of the Manufacturing Chemists' Association in New York City. Mr. Bliss is of the opinion that one way to beat research costs lies in more cooperation between companies. "Frequently," he said, "the same technical area is researched over and over again, simply because we so seldom are permitted to know what the other fellow has been doing." The chemical industry, he pointed out, is fast getting to the point where it can no longer afford the "luxury" of duplicating research efforts. In the light of the increasing complexity of technology, more cooperatively sponsored research projects are virtually inevitable, he said.

The value of research, of course, cannot be overestimated. One chemical company estimates that for every one dollar spent in research, development and other experimental costs, it reaps at least $5.60 in new sales after five years. Another chemical company says that in the last five years its total employment went up 28.5 per cent, but its technical personnel in research increased 49.5 per cent.

The adhesives industry, a relatively new entity, is dependent upon research activities to a far greater extent than many other manufacturing branches. In order to keep pace with growing and more complex demands, the adhesives manufacturer expends a good deal of time, energy and money in the pursuit of new products for unique applications.

The time may now have come for the adhesives industry as a whole to give more complete thought to this matter of research. If we were to substitute the word "adhesive" where Mr. Bliss uses the word "chemical," we may have a beginning to the solution of a vexing universal problem.

It may be said without fear of contradiction that many adhesives companies are currently engaged in research activities which are, by-and-large, being duplicated by other companies in the field. We are cognizant of many of the problems involved in a mutual approach to research problems, the matter of competitive position being one, legality, another. However, in the full context of research programs, there are likely many areas which could be explored on a mutual basis with concurrent benefits to all.

ADHESIVES AGE will serve this aim in one respect, since it serves as an "open forum" for the discussion of mutual problems. A more "open" attitude on the part of companies in the field in reporting their research findings would also be helpful. In essence, however, the problem will remain—the problem of duplication of effort.

It may be that a mutual research program can be handled through some organization currently in existence. Perhaps one of the associations might be employed for this purpose. We are firmly of the opinion, however, that there is much to be gained by cooperative approaches. It may be possible to make the research dollar go twice as far. We welcome our readers' comments on this subject.

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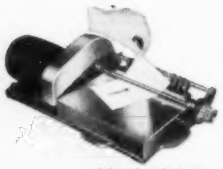

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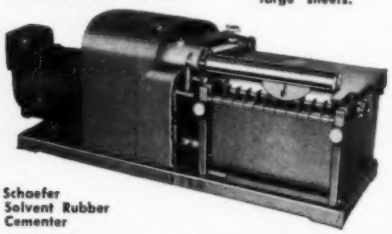

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By Dr. Irving Skeist

Adhesion of Wax Paper

Question: How can we improve the adhesion of wax paper for food wraps, without spoiling the gloss?

Answer: Paraffin wax is one of our older, less-glamourized raw materials for coatings and adhesives. It is used in the packaging of bread, cupcakes, lollipops, candy bars, chewing gum and many other edible products. Other waxes are important as adhesives and coatings in military and export packaging. As a coating material, the chief virtues of paraffin are water and moisture resistance, low cost, ease of application, non-toxicity, good color and glossy appearance.

But the shear strength and peel strength of adhesive bonds made with unmodified paraffin leave something to be desired. Paraffin wax itself consists predominantly of straight chain hydrocarbons of rather short length, a sort of polyethylene in embryo, but without the high strength and toughness that polyethylene gets from its high molecular weight. Because the molecules crystallize readily when cooled, the paraffin coating is shiny. Whether made by sweating or by refining slack wax with methylethyl ketone and other solvents, refined paraffin wax contains less than ½ per cent oil, and consequently does not block in a heavy roll of paper, even though its melting point may be as low as 122°F.

Some thirty years ago, it was found that the adhesive properties of paraffin wax could be improved by blending with *microcrystalline* wax. Micro waxes are of many kinds; the most important are the *residual* waxes left in the refinery still. They differ from paraffin waxes in that they are higher melting (145-175°F.), higher in molecular weight and viscosity, and crystallize in tiny needles instead of the large platelets of paraffin wax. The micro waxes tend to be branched, while paraffines are mostly straight chain. Most important of all, the micro waxes are flexible and tough.

The micro waxes are excellent adhesives, and are used alone for laminating paper to paper, paper to aluminum for candy wraps, cellophane to scrim for military packaging and many other applications. But they cannot be employed by themselves as a coating for bread wraps as they are tacky, colored, and lacking in gloss.

The freshness of a loaf of bread depends to a considerable extent upon the retention of moisture by the package. If the wrap is a wax-coated paper, both

the bottom seal and the two end seals must remain intact from bakery to market to kitchen. A good adhesive bond is essential.

At the same time, a glossy coating is demanded. Waxing machines are being forced to higher and higher speeds, making the attainment of gloss more difficult. Since the end of World War II, it has become customary to include a few per cent of *polyethylene* to build up the gloss. This complicates the adhesion problem, as polyethylene is notoriously abhesive (non-adhesive).

Here are some suggestions for the formulator:

(1) Explore and take advantage of the tremendous variation in micro waxes. The higher melting ones are not necessarily the best.

(2) The lower molecular weight polyethylenes, available from two manufacturers, may give almost as much gloss as an equal percentage of high molecular weight polyethylenes, with less damage to adhesion.

(3) Where it can be tolerated, a small percentage of *butyl rubber* will work wonders on adhesion. So will *polyisobutylene*, which is butyl rubber without the cross-linking component, therefore thermoplastic, therefore smoother handling than butyl rubber. Unfortunately the polybutene is twice the price of the butyl; but only a small percentage is needed. With both of these materials, the higher molecular weights are less tacky and have less tendency to block in the finished product. However, these larger molecules are harder to handle during production. They raise the viscosity of the molten wax, necessitating higher operating temperatures with consequent greater tendency toward oxidation and discoloration. In addition, they may bring down the coating rolls with an ailment known as "strings" or "spiders," especially at high machine speeds.

Thus it can be seen that the wax should contain a number of ingredients, carefully selected and balanced, to give the optimum combination of gloss *plus* adhesion.

Heat Sealing Glue

Question: We are interested in obtaining information on a heat sealing glue and the method of applying such glue in our plant on folding paper boxes so that the closings may be sealed by the customer in his plant.

Answer: Many heat-activated glues are available for boxboard; the *polyvinyl acetates* are currently the most popular. The real problem is, how do you get heat through the thick layer of boxboard to the glue? A machine is available for end flaps. For other applications, one way to reach the glue is with *dielectric* or ultra high frequency *heating*.

It would be worthwhile to try a *delayed tack* adhesive. These are patented compositions containing solid plasticizers, which solidify slowly once they have been melted.

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

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Cement For Viton

Viton synthetic rubber may be bonded to itself with Fairprene 5199, a fluoroelastomer composition. The cement has a heat resistance of from 400° to 450°F. Its chemical resistance is said to be outstanding except with regard to ketones and chlorinated hydrocarbons. Thinned with methylethyl ketone, Fairprene is supplied with a separate activator which must be thoroughly mixed into the cement prior to use. The ratio is 5¼ grams per pound of cement. Activated cement has a pot life of at least 20 hours. Fairprene can also be used as a protective coating. Though the cement is formulated with a flammable solvent, the cured film does not support combustion. *Fabrics Div., E. I. du Pont de Nemours & Co., Inc.* **P-58**

Marine Patcher

A marine patching resin has been developed which is formulated by the addition of minute fibers to specially treated Plaskon polyester. The fibers produce a smooth surface which adds strength and bonding qualities to the final laminate. The boat patch polyester sands smoothly without fouling abrasive paper and has minimum shrinkage during the cure. Use on overhead surfaces does not require curtaining or dripping. The fiber-reinforced resin is said to have greater film thickness and tensile strength than conventional resins and its finish has more impact and compressive strength. *Neehi Protective Coatings, Inc.* **P-59**

Epibond 1210

Demonstrating exceptionally good bond strength to cured polyesters, Epibond 1210 is cured with an equal weight of hardener 9829. It has a pot life of 70 to 80 minutes and develops a bond strength of 1800 psi to polyesters and 3500 psi to aluminum. With a room or slightly elevated temperature cure, good bond strengths are developed for thin or thick glue lines when bonding polyesters. Usually bond failure occurs within the cured polyester. *Furane Plastics Inc.* **P-60**

Duct Sealing Tape

Specifically designed as an effective means of joining and sealing sections of duct work in heating, ventilating and air conditioning systems, Permacel 676 Silver Duct Sealing Tape is a new vinyl coated, pressure-sensitive product. The combination of cloth backing and a specially compounded adhesive provides an

effective seal against air leaks and insures permanence on the job where sealing of joints and sections of duct work are indicated. It has excellent resistance to extreme temperature fluctuations as well as solvents, abrasion and aging, states the manufacturer. *Permacel.* **P-61**

Contact Adhesive

Essentially odorless, non-flammable and non-hazardous, Formica Safe-Bond can be brushed, rolled or sprayed on plaster, hardboard, plastic laminates, plywood and numerous other materials. It has a spread rate of 300-320 square feet per gallon. The manufacturer points out that heat resistance is good and that clean-up is easily accomplished. *Formica Corp.* **P-62**

Epoxy Novolac Resin

An experimental material, X-2638.3 may be used in high-strength adhesives for metal fabricating, printed circuits, and glass reinforced laminated for structural shapes. The epoxy novolac resin is also available in an 85 per cent solids solution. *Dow Chemical Co.* **P-63**

Epoxy Insulator

Protection for all class A and B electrical equipment is provided by Epoxylite, a new epoxy insulator. Applied without the use of solvents, it hardens into a dense, capillary-free structure devoid of moisture-conducting passageways. It is chemically inert and has unusual resistance to chemical attack. Boiling caustics and concentrations of acids strong enough to corrode and destroy steel leave Epoxylite unaffected, the manufacturer points out. A thermosetting compound consisting of a rigid molecular network crosslined in all three dimensions, it cannot soften, swell or degrade in oils, plasticizers and solvents.

It bonds so well to metal that it is used as a high-strength adhesive. Laminated with glass cloth, it has replaced steel for certain structural applications. Epoxylite is said to withstand stresses and vibrations that would quickly destroy conventional coil insulation. Because its coefficient of thermal expansion is matched closely to that of metal, normal variations in operating temperatures will not cause cracking. Heat from the conductor is evenly and continuously dissipated. Therefore, a protected motor runs cool and windings remain in excellent condition for years. *The Epoxylite Corp.* **P-64**

Conductive Cement

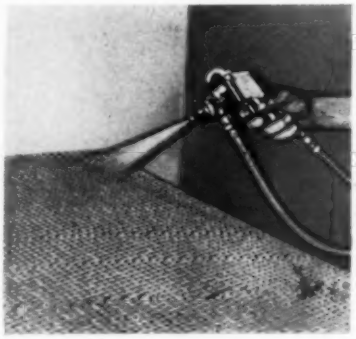
Based on epoxy resins, Hysol 6250 is a conductive cement which cures in 24 hours at room temperatures, or in two hours at 140°F. Especially recommended for repair of printed circuits and bonding electrical components where soldering is impractical or not to be tolerated, it will, however, bond to most materials. It is a 100 per cent solids compound and its volume resistivity is 0.01 ohm-cm at 25°C. Hysol 6250 is supplied in kit form. *Houghton Laboratories, Inc.* **P-65**

Soluble Caseins

Four new cold-water soluble caseins announced need only ten minutes of alkali soaking and about 30 minutes of mixing at from 60° to 80°F. Most caseins need up to 60 minutes of heating at from 130° to 180°F. after soaking and the addition of alkali. PV-424, PV-428, PV-430 and PV-800 are for use in paper coatings, paints, inks, adhesives and textile finishing. *Borden Chemical Co.* **P-66**

Honeycomb Adhesives

Designated as EC-1177 and EC-1415, two newly available resin-type thermosetting adhesives can be used for bonding phenolic impregnated kraft paper honeycomb to thin aluminum, stainless steel, or magnesium sheeting. In application, the metal is first chemically cleaned and



thoroughly dried before a 0.007-inch thickness of the adhesive is sprayed on. A 0.015-inch thickness of the adhesive is sprayed on the faying edges of the honeycomb core section. Following a 30-minute drying period, the coated metal sheets and honeycomb core are put in an oven and dried for 10 minutes at 190°F. After they have cooled the sheets and core are mated and the panel placed in a press under approximately 15 psi pressure for a maximum of 15 minutes at 300°F. Excess adhesive is easily removed with alcohol.

EC-1177 is transparent, has a synthetic resin base and a heavy syrup consistency. It weighs about 7.7 pounds per gallon and is diluted with an equal volume of acetone for spraying. EC-1415 adhesive has a transparent amber color, a synthetic resin base and a medium syrup consistency. It weighs about 7.4 pounds per gallon and can be sprayed as received. *Adhesives Coatings and Sealers Div., Minnesota Mining & Mfg. Co.* P-67

Anti-Adhesive

Thorough release from kraft, glassine, parchment, multiwall bag liners, boxboard, plastic film and other packaging materials is possible through the use of Syl-off silicone paper coatings. Permanent and water repellent, the coatings will not contaminate, migrate or alter stocks or packaged products. *Dow Corning Corp.* P-68

High-Speed Adhesive

No mixing or metering before use is required with Isobond 331, an internally catalyzed and flexibilized epoxy adhesive formulation. Designed primarily for high-speed production use, this new product has good adhesion to metals, glass, ceramic and most plastics. Bonded aluminum has a shear strength exceeding 3000 pounds per square inch; bonds to glass are said to be so strong as to be beyond measurement as the glass itself delaminates on test. Since Isobond 331 is moderately resilient, materials with a wide range of expansion coefficients can be successfully bonded without causing thermal stresses. It has outstanding chemical resistance towards most acids, alkalies and solvents. The indicated minimum shelf life is six months at 72°F. The manufacturer points out that it cures very rapidly even at moderate temperatures; two and a half hours at 250°F. or 15 minutes at 335°F.

For clean-up purposes, Isoterge 1405 is recommended as an excellent resin detergent which converts uncured resin to a water dispersible system. Solubilized resin can be flushed down the drain. *Isochem Resins Corp.* P-69

Rub-On Cement

Made of plastic rubber compounds, DRY-stik is a recently developed adhesive for paper. It is marketed in dry bar form and when rubbed on a surface leaves a thin pressure sensitive coating that is not sticky to the touch. Paper sticks instantly, but can be picked up and moved many times. When smoothed down firmly, the adhesive forms a waterproof bond stronger than the paper itself. Odorless, non-flammable and non-toxic, DRY-stik does not stain, wrinkle or shrink the paper. It bonds tight at the edges without oozing. *DRY-stik Co.* P-70

Polyethylene Adhesive

Polytex is especially designed for bonding burlap, osnaburg and other fabrics to polyethylene. It is said to remove difficulties encountered by bag and shoe manufacturers seeking to laminate polyethylene with a wet adhesive instead of with heat-sealing. It is recommended for the manufacture of bags used for feed, fertilizers, etc. *Java Latex & Chemical Corp.* P-71

Polyisocyanate Foams

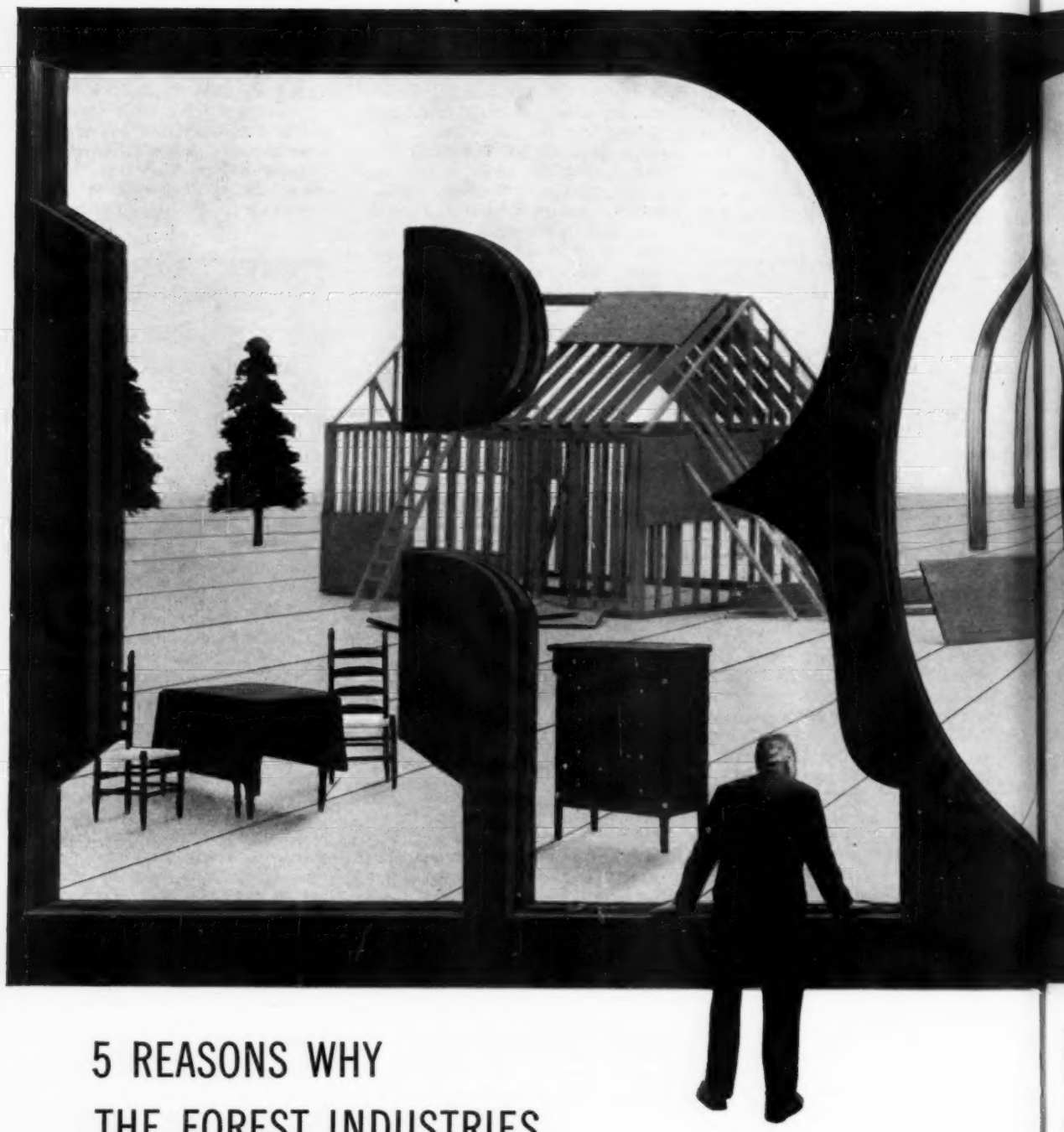
Two new thermosetting, self-curing polyisocyanate foams for insulating and reinforcing voids between structural members are announced. "Scotchfoam" Brand Expansible Compounds Type A and Type 1 are said to be especially adapted to filling cavities where light weight, structural

strength, stiffening, vibration dampening, and durability are desirable factors. Both compounds are two-part liquid formulations which when mixed with a catalyst can be foamed-in-place. Application to desired areas may be made by pouring or spraying. Type 1 has a volume expansion of approximately 20 to 1. Features include adhesion to most metals, plastic wood, glass and ceramics; low weight; and curing without heating.

Type 1 is supplied in formulations to produce resilient foams of two pounds per cubic foot density up to rigid foams with densities of 20 pounds per cubic foot. Type A is supplied in formulations with a four pounds per cubic foot density. *Adhesives Coatings and Sealers Div., Minnesota Mining & Mfg. Co.* P-72

Floor Adhesive

Wood, metal, plastic, cork, leather, fabric and many other materials may be either wet or dry bonded with Dri-Tac. For use on floors, walls, ceilings and other surfaces, the adhesive requires the coating of only one surface to form a strong permanent bond without the use of presses or clamps. Coated materials may be bonded years after the original application by merely removing a release paper. The non-inflammable liquid product can be applied by any conventional method. No primer is necessary. Dri-Tac dries transparent and does not stain. *Adhesive Products Corp.* P-73



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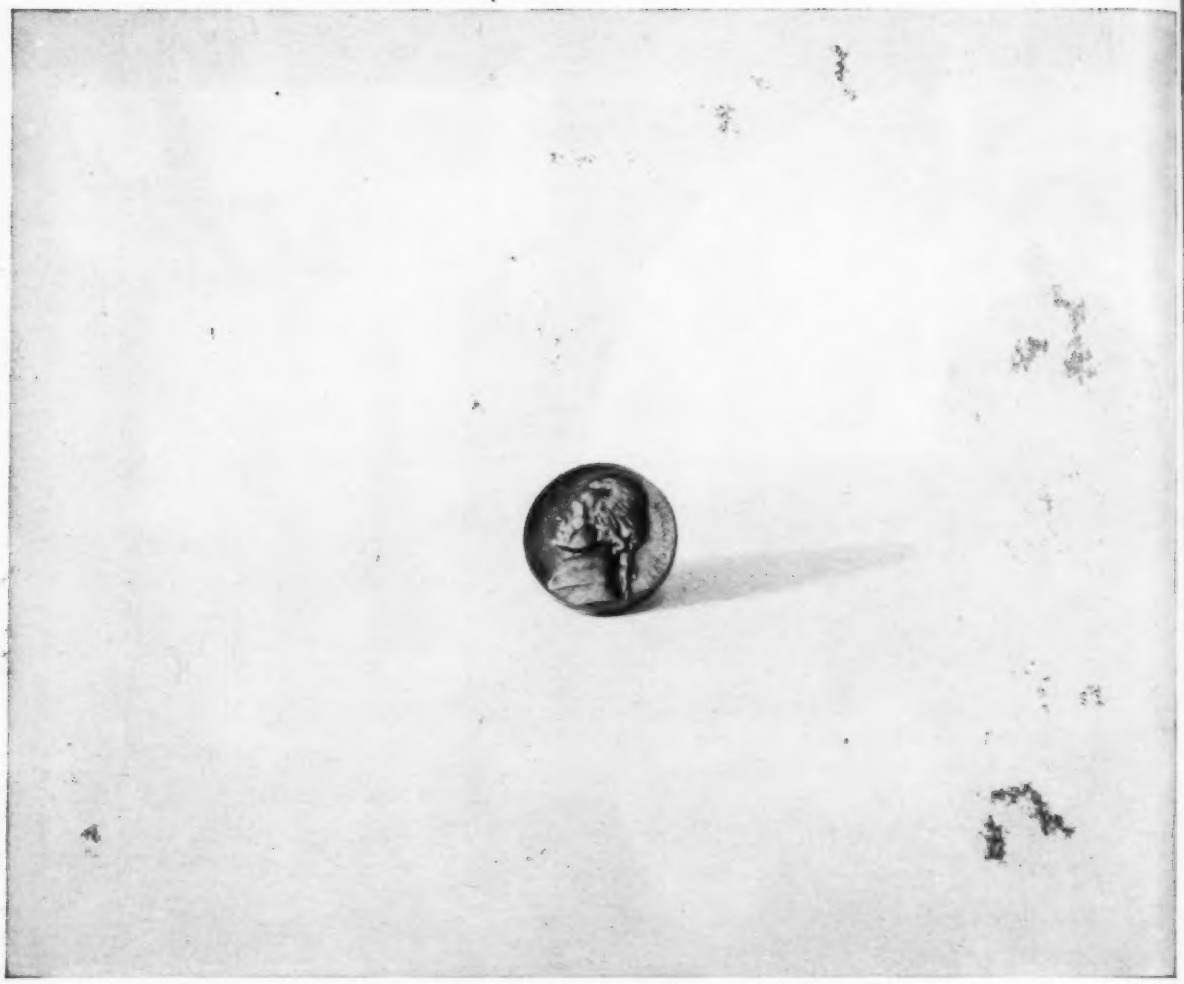

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- Is reactive with aldehydes to form resins.
- Is substantially insoluble in aliphatic hydrocarbons.
- Is compatible with a wide range of resins and plasticizers.

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Acid Number	94
Saponification Number	165
Gasoline Insoluble	83%
Oxygen Absorption	0.25%

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NV-58-1

THE MOST LIBERAL CONGRESS IN TWO DECADES is just getting organized in Washington. The expanded bloc of "progressive" Democrats is out to extend its election victory and ram through its own programs. These men won't win every goal, but they'll make a noticeable mark. And the liberal fever is affecting Republicans, too, now that a group of their leading conservative members have retired or been defeated. As a result, GOP opposition will be less vigorous.

The big issue will be spending. The President says we must cut outlays or face ruinous deficits and inflation. Liberals claim our economy is strong enough to afford more government services. The result: the greatest number of vetoes since Ike took over.

Other than the running fight over appropriations, 1959 mainly will be one of laying groundwork. That is usual in the first session of a new Congress. Investigations will take up a lot of time—inflation and defense policy occupying the spotlight. Non-Budget legislation passed by this Congress will be light.

Congress will save its big accomplishments until next year, when they will be fresh in the voters' minds on Election Day.

THE COMING BATTLE OVER THE BUDGET for fiscal 1960—the year starting next July 1—won't come out to the Administration's liking. Eisenhower will go down the line for balance, proposing a little more for missiles, nuclear submarines, and other military weapons, with offsetting cuts proposed in many civilian activities. To get the Budget in balance, cuts will have to go deep.

But Congress, led by the liberals, won't go along. Many of the lawmakers think we need more defense. And they feel that they were elected to increase—not pare—strictly civilian services. So spending will top Ike's recommended $77 billion by $2 to $4 billion. Nor will Congress buy Ike's proposals to lift revenue, like higher postal rates and interest charges on federal loans.

NO BIG CHANGES IN TAX RATES ARE COMING this year, though there will be special adjustments important to many businessmen. The end of the recession has killed off the big argument for cuts for individuals and corporations. The large $12 billion deficit looming this fiscal year also makes any talk of cuts unrealistic. A tax hike might be more in order, but politics rules it out.

This session, as suggested above, will see plenty of spadework for substantial revisions of the Tax Code provisions on estates and trusts, partnerships, corporate reorganization, unemployment compensation, and social security. Action won't come until 1960.

DON'T GO OVERBOARD ON 49-STAR FLAGS with the new design to take care of Alaska just announced. The admission of Hawaii as the 50th state seems to be a sure thing in the coming session. Both parties are pledged to the idea.

Here are a few specific changes that may even pass this year:
- Auto excises, now 10% of manufacturers' prices, may be reduced to 5% or dropped entirely, if car sales do not start gaining.
- Depletion allowances for foreign oil earnings may be abolished.
- Life insurance rates will be revised; they'll be hiked by 50%.
- Federal gasoline taxes may be increased 1¢ or 1½¢ from today's 3¢-a-gallon rate to keep the highway program from going broke.
- Small business may get from Congress such help as deductions for private pension funds and fast depreciation on used tools.

A BIG FIGHT OVER LABOR LEGISLATION, maybe the biggest after spending and defense policies, is sure to come in this session. Only this time, the unions and not the Administration will be calling the shots. With election returns as their ace, the unions are preparing programs to get much of their priority legislation voted into law. And they may have quite some success.

The Democrats, especially the liberals, are preparing to go a long way to grant the unions' requests. And many Republican Congressmen, mindful of the last election, will go along, too.

These are the major labor issues which may get action in 1959:
- Labor reform: A measure along the lines of the Kennedy-Ives bill of the last session probably will pass. The unions are for it. It would clean up finances, voting procedures, etc.
- Minimum wage: There'll be hearings on proposals to increase the minimum from $1 an hour to $1.25 and extend jurisdiction to 10 million in trade and services. In the past, Congress has handled one of the two—either a higher rate or greater coverage—in any one year. This time, the hike to $1.25 has the edge for passage. The final vote won't come 'til 1960.
- Jobless pay: The states' rights issue may prevent adoption of bigger benefits for longer periods under U.S. standards.
- Right-to-work: The unions will press hard for a bill which would ban state right-to-work laws. It won't pass in 1959.

ANTITRUST LEGISLATION WILL ENJOY CONSIDERABLE INTEREST at this session. Congress is likely to vote to require advance notice to the Justice Department of mergers of big firms and to let private parties sue for treble damages for violations of the Robinson-Patman Act, as is done under other antitrust acts.

Congress probably won't vote for a federal Fair Trade law, or require leading companies to post price hikes in advance. And it isn't likely to overturn the Supreme Court's ruling that good faith in meeting a competitor's price is a complete defense to price-discrimination charges. There'll be a spate of probes—petroleum pipelines, antibiotics, shipping, tires, and baking.

HOUSING LEGISLATION MUST BE PASSED this year. Many programs will be running out and new authority is needed to continue them. The President is preparing to recommend cutbacks in funds for urban renewal projects, public housing, college housing, and community facilities. The Democrats will be fighting not only to renew all of these programs but to expand some as well.

• United States imports of gum arabic during the first seven months of 1958 were 14 per cent ahead of those in the equivalent period of 1957, with a monthly average of 1.6 million pounds. If maintained at this rate, 1958 imports will approximate 19.2 million pounds, the 1957 total. Despite decreases of 16 per cent and 9 per cent, respectively, in the January-July period, 1958 imports of tragacanth and karaya will probably approximate those for 1957.

Locust bean gum imports gained 31 per cent in the January-July period of 1958 over those in the first seven months of the preceding year. Efforts are being made to recover the market previously held in 1956 when the commodity was competitive with other gums.

The Sudanese market for gum arabic has improved since the beginning of 1958. World demand has been fairly active, according to recent reports from that area, with exports for the first half of last year amounting to 26,281 tons, valued at 2,846,407 Sudanese pounds (about $8,254,000), compared with 19,148 tons, having a value of 2,072,569 Sudanese pounds (about $6,010,500) in the corresponding period of 1957.

New crop arrivals in Kordofan and other stations in the Blue and Upper Nile Provinces totaled 37,200 metric tons at the end of the second quarter of 1958, approximately the same as those in the two preceding years. It is believed that almost 90 per cent of the total gum hashab crop for the 1957-1958 season has already been placed on the market. Because stocks have been low, prices have continued to rise and now stand at 129 Sudanese pounds (about $374) per ton, c. i. f., English port. Unsold stocks are understood to be smaller than those of any corresponding time in the last three years.

• Reichhold Chemicals, Inc., has announced plans to establish, jointly with prominent Hong Kong industrialists, a Hong Kong affiliate for the manufacture of the company's entire line of industrial synthetic resins. The new company will be known as Reichhold Chemicals (Hong Kong) Ltd.

At present, plans are underway for the construction of a two story plant in the industrial section of Hong Kong with production scheduled to begin in the spring of 1959. Products of the plant will be available for use in the paint, paper, textile, printing ink, woodworking and polyester industries.

The Hong Kong plant will be the 38th Reichhold facility in the world. In the Far East, the firm has manufacturing plants in Japan, the Philippines, Australia and New Zealand. Reichhold also maintains a number of area sales offices, including one in Hong Kong.

• America's mixing-metering and dispensing pump for 2-part resins is now manufactured in Europe. A German manufacturer of chemical machinery, Josef Baer, Maschinenfabrik, Weingarten/Wurttemberg, has been licensed to manufacture a new version of the well-known Triplematic Mixing-Metering pump, made by H. V. Hardman Co., Inc., Belleville, N. J. This pump was designed for use with epoxide and resorcinol 2-part, self-curing resins and consists of a pumping system for the hardener (curing agent). The pumping systems are balanced and interconnected so that the correct ratio of resin to hardener is accurately maintained.

Materials are pumped in their correct ratio into a mixing chamber located immediately above the ejection nozzle, where the mixture is blended mechanically to a perfect consistency without entrapped air. From the mixing chamber, the blended resin is accurately metered by a metering pump through a nozzle fitted with an electro-magnetic anti-drip, cut-off device. Very small metering amounts to metering amounts of reasonable quantities are possible with this machine. A feature of the machine is that if the metering amounts are altered, no alteration takes place in the blending ratio of resin to hardener. Adjustments to alter the ratio of resin to hardener are accurate and take only a minute.

• Austrian production of plastics materials has increased from 10,900 tons in 1956 to 12,000 in 1957. Another sharp increase is expected within the next two years with the completion of two large projects. One to be carried out by Halvic Kunststoffwerke GmbH, involves greater production of polyvinyl chloride, which will be increased from 3,000 tons to 8,000 tons. In the other project, Vereinigte Chemische Fabriken Kreidl, Rutter & Co., will step up formaldehyde production from 5,000 tons to 13,000 tons.

• A nationalized Austrian factory has been sold to private interests. Under the provisions of the Austrian State Treaty, a number of former Soviet-administered and other ex-German chemical enterprises became the property of the Austrian Republic. Government policy now calls for the sale of these enterprises to private business. Recently A. G. fuer Chemische Industrie, Vienna and Rannersdorf, Lower Austria, which produces glues, gelatin, bone meal and other products, was sold to a private Austrian bank, Mayer-Loos K. G., Vienna.

• More than 350 delegates attended the Fourth Reinforced Plastics Technical Conference, organized by the British Plastics Federation and held in Brighton, England, recently. For the first time, delegates from companies which are not members of the British Plastics Federation were permitted to attend.

Four papers from the United States were presented at the conference, including "Development of Flake Glass Laminate," by Professor C. R. Rugger (Picatinny Arsenal); "Structural and Heat Resistant Asbestos Reinforced Plastics" by D. V. Rosato (Raybestos-Manhattan); "Technical Requirements for Reinforced

On the Continent

Plastics—An Outlook for 1958-63," by W. M. Keller (Owen-Corning Fiberglas); and "The Rand Process of Simultaneous Deposition of Fibreglass and Resin," by D. F. Anderson (Rand Development).

A total of 38 different papers were presented at the conference, the object of which was to explore various means of improving reinforced plastics. Before the conference was concluded, the chairman reviewed the papers presented and gave his personal comments. It was felt that technical cooperation would be required since the industry has outgrown the scope of individual companies.

• The development of stickiness, a current effect in rubber processing, is characterized by a surface adhesivity of the sample with a consequent loss of the highly resilient properties of the materials when the degradation is followed by a partial return to the plastic state.

This effect of aging is among the most harmful because it causes deep degradation of products. The Messrs. Danjard, Toulec and Langlade of the French Rubber Institute, have carried out extensive research to determine the mechanism of this effect and to find an efficient system of control.

A formula has been developed which allows a near perfect inhibition of stickiness, even under the severest conditions. The formula consists of 1 per cent of zinc mercaptobenzimidazolate; 0.5 per cent of phenylcyclohexyl-p-phenylenediamine; and 0.5 per cent of 2-6 ditertiobutyl-4-methylphenol.

This compound is said to offer a specific protection against the development of stickiness, since the protected vulcanizate is not only degraded much slower than reference, but bears no marks of stickiness, even after a total loss of tensile strength.

• International efforts to coordinate and establish standards for technical expressions and definitions in all major languages have been making considerable progress. The first session of the Technical Committee ISO/TC 61, which took place in New York in 1951, adopted a resolution to establish international multilingual standards and definitions for the adhesives and plastics industries.

Last year, a list of 872 definitions and technical terms in English, French and Russian were established. These definitions and technical terms encompassed raw materials; plastics and adhesives; their characteristics; methods of testing and processing; and the machinery used for their manufacture. A supplement contains the equivalent technical definitions and expressions in German, Spanish and Italian.

The German plastics industry recently submitted proposals for German standards concerning polystyrene, which covered definitions; characteristics; test methods, etc. "Kilopond," abbreviated "Kp," was suggested as a new expression for "unit of power." This new word is expected to receive official status under a law to be enacted by the German Federal Republic. This is one of the examples of the new trend, which makes it difficult to keep dictionaries up to date and makes international scientific communications more and more complicated.

• A new fish glue, made from scales of small herrings, has been developed by a fish combine in Astrachan, U. S. S. R. The organization has succeeded in recovering 6 to 10 per cent of glue by boiling degreased waste liquids containing herring scales. This glue has a viscosity of 2°Engler, the contents of solid residues amounting to 35 per cent. The quality of the glue is below that which is obtained by processing scales of larger fishes. Contact glue, having a viscosity of 2°Engler; a solid residue content of 60 per cent; and a breaking strength of 284 pounds per square inch, is recovered from the waste liquids of fish meal factories at the rate of 10 per cent.

• An Italian patent provides two adhesive formulas for the lamination of paper with aluminum foil. The first consists of 6 parts (grams) casein; 2 parts thriethanolamine; and 4 parts of a solution of NH_4OH (28°-Bé). The second is composed of 2 parts of linseed oil; 4 parts of NH_4OH solution (28°Bé); 0.10 phenole or 4 parts urea; 0.5 paraformaldehyde or 3 parts thiourea. In each case, water is added until a volume of 100 cubic centimeters is reached. It is said that these formulas give excellent results.

• A British publication informs its readers that the Palmerton Publishing Co., Inc., of New York, is bringing out a monthly journal called ADHESIVES AGE; ". . . those of the British readers who are already familiar with their other publication RUBBER AGE, will expect something good from ADHESIVES AGE. It is significant that the Americans realize the growing importance of the adhesives field."

• British Glues and Chemical Ltd. has had a very successful year. A dividend of 8 per cent will be paid for the preferred shares and the holders of common shares will receive a 20 per cent dividend. In addition, a net profit of approximately $350,000 will be carried over. The leading position of the company has been gained by accelerated research and development of new processes and techniques.

• The director of the Daimler-Benz factory at Stutgart, Germany, recently spent several days at the Motor show in London. He also visited the CIBA factory at Duxford, England, where "Redux" synthetic resin adhesives are made. These adhesives are used to bond friction linings to brake shoes on Mercedes-Benz cars.

• The 1959 British Factory Equipment Exhibition, to be held in London on April 7 to 17, will be a shop window for the world's industrialists. The seventh—and biggest—exhibition will show a wide range of factory equipment for all types of industry throughout the world.

• According to the latest statistics, France has 90 vehicles per 1,000 inhabitants compared with 51 in Germany, 82 in Britain, and 25 in Italy. In 1957, France built 12 new cars for every 1,000 inhabitants compared with 11 in Germany, 9 in Britain and 4 in Italy. Germany makes more cars, but exports more and has a higher population.

News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

Easy-to-spray "cold contact" adhesive yields lower unit costs

TECHNICAL DATA ON

Bond*master*® G592

A "cold contact bonding" liquid adhesive for the mass-production-bonding of rigid and semi-rigid materials such as decorative laminates, linoleum, metals, most plastics (rigid or flexible), some rubber stocks, wood, etc.

BOND CHARACTERISTICS

This adhesive is exceptionally strong, features high heat resistance, and resists delamination at advanced temperatures.

APPLICATION

Apply BONDMASTER G592 to *both* surfaces to be joined. Because of the fast-drying solvents used, drying takes place swiftly at room temperature; alternately, the adhesive may be force-dried (infra-red or ovens) if more rapid assembly is desired.

VARIABLE "OPEN TIME"

Components can be bonded at room temperature virtually instantaneously, or as long as two hours after application of adhesive. Even after two hours, sturdy bonds can be achieved by heating one surface before combining.

In all instances, a firm, sturdy bond will be achieved "on contact" as the two materials are mated between pressure rollers.

Note: Several variations of this formulation are available for exterior wall panel manufacture. Write for data.

R&A SINCE 1913

RUBBER & ASBESTOS CORPORATION

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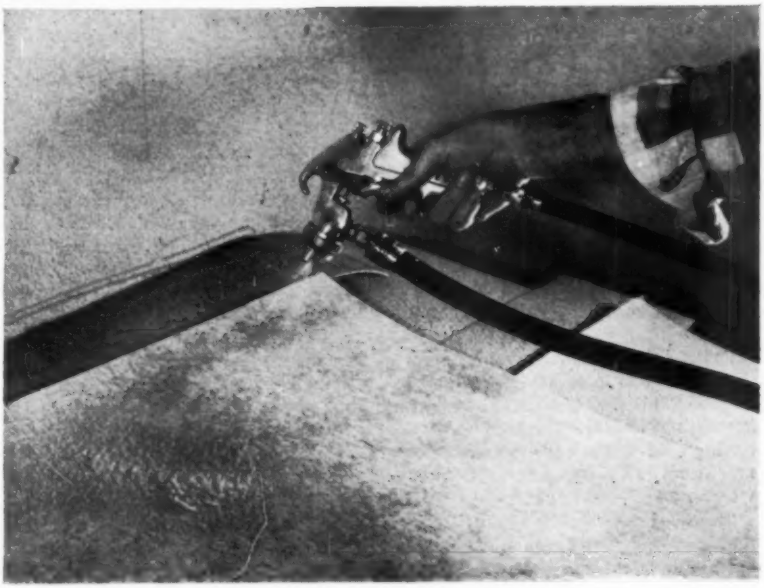


This unusual "chemical fastener" is an offshoot of the R&A thermoplastic ("hot contact") adhesives widely used in "curtain wall" panel construction. It offers three distinctive cost advantages:

- BONDMASTER G592 bonds easily, swiftly, and uniformly with conventional equipment. In the words of a leading manufacturer of linoleum-topped steel desks: "It does a faster job . . . goes further . . . does more work per gallon."
- This unique sprayability lets you eliminate wastefully heavy glue lines without sacrificing high bond strength. That translates directly into dollar savings per gallon.
- Its special solvent blend permits this formulation to dry quickly at room temperature. No need for costly heating equipment. (Substantial labor savings, too.)

DEVELOPED FOR MASS PRODUCTION

BONDMASTER G592 is recommended where faster assembly speeds are required for more profitable mass production. It is *not* suggested for "job shop" work . . . is normally available in 55-gallon drums only.

WRITE FOR FURTHER DATA

Send for profusely illustrated magazine reprint ("Modern Building Wall Adhesives and Assembly Techniques Speed Desk Top Bonding") and detailed Technical Data Sheet.

We'll be glad to send a free sample as well if you will describe your bonding problem in detail.

Space Age Adhesives

By F. H. BAIR
Materials Laboratory
Wright Air Development Center
Dayton, Ohio

Prescribing adhesives for space vehicles of the future calls for ingenuity and inventiveness

First developed only 15 years ago structural adhesives are expected to play an important part in space-return vehicles of the future. Extensive tests at the Wright Air Development Center have indicated that adhesive properties such as resilience, galvanic insulation and thermal shock can make a valuable contribution to the successful bonding of metal alloys into composites having the necessary requisites of maximum strength and minimum weight.

Before investigating space conditions which future high performance adhesives will be expected to meet, it might be helpful to survey both early and current uses of these products. It was not until some time after the introduction of Chrysler Corporation's Cycleweld that adhesives were used extensively in load carrying structures.

The first practical adhesive, Cycleweld has good strength and fatigue properties but is somewhat deficient in moisture permanence. Its introduction was quickly followed by those of Redux, Plastilock and Meltbond. However, structural adhesives had to prove themselves and the possibility of "gluing" planes together met with general apathy by the manufacturer.

The first breakthrough came during the development of metal helicopter blades. It was found that blades joined by rivets, spot welds or bolts would not withstand the severe fatiguing to which they were subjected during flight.

Practical tests soon showed that the resilience and damping properties of organic adhesives helped extend the life of bonded blades *several hundred* times. The news of these unusual results jolted the industry into trying adhesive bonding first on secondary structural parts and later on primary structural parts. The results obtained depended largely on whether or not the assemblies had been originally designed for adhesives bonding.

Sandwich Construction

Structural adhesives really got underway with the introduction of the concept of sandwich construction, a technique which obtains higher strength per weight than any other way of deploying materials. Because of the latter and other properties, sandwich construction soon became the oustanding method for building air vehicles.

For example, the extent to which adhesives bonded assemblies are used in the B-58 supersonic bomber is shown by the shaded areas of the drawing in Figure 1. The wing panels are phenolic-fiber glass core materials bonded to aluminum facings. The fuselage sections are bonded laminated metal with longeron hat stiffness filled with aluminum core in which all elements are bonded together.

At the present time, adhesive bonding is included in all air vehicles and is an important design consideration in all being planned. Because other methods of joining would have resulted in weights beyond which the structures would function or be useful, several of our present weapon systems would not have been at all possible without adhesive bonded assemblies.

As flight speeds increased, the necessity for higher temperature resistant adhesives became evident. Organic adhesives for bonding low to intermediate temperature resistant structures have been quite well standardized, but now the emphasis is shifting to bonding metals other than aluminum alloys.

Figure 2 shows at a glance the results now obtainable in bonding stainless steel. It should be pointed out, however, that not all adhesives will withstand aging in steel assemblies. Figure 3, which shows shear stress in relation to aging time at temperature, indicates that epoxy-phenolic adhesives deteriorate quite fast at 500°F. However, the use of primers on the metal help somewhat. Experimental epoxy-phenolic-silicone look promising but have low strength. The inorganic adhesives in the advanced experimental state do not lose strength on exposure to 1000°F.

This pretty well summarizes the progress made in high performance adhesive up until a year ago. Organic adhesives to withstand about 500°F. had received phenomenal acceptance and the amount sold to the aircraft industry ran into millions of dollars. In addition, promising results were being obtained on development programs for adhesives to go to much higher temperatures.

In the Fall of 1957 the news was flashed around the world that Russia had placed a satellite in orbit and everybody contracted a severe case of space virus. The accompanying requirements "fever" was terrific —simply out of this world.

Talk about airplanes gave way to talk about space vehicles of one type or another. The species most talked about now are space-return vehicles. So let's go out into space and see what conditions future adhesives specimens will have to withstand.

Temperature is one very important consideration, especially in return into the atmosphere. It is generally considered that equilibrium skin temperature may reach as high as 2500°F. It is possible that stagnation temperatures on the leading edges of a 75 degree angle swept wing may be 4000°F. or above. Some tests have been made on materials at temperatures of 16,000°F. for short times.

Meteorite Erosion

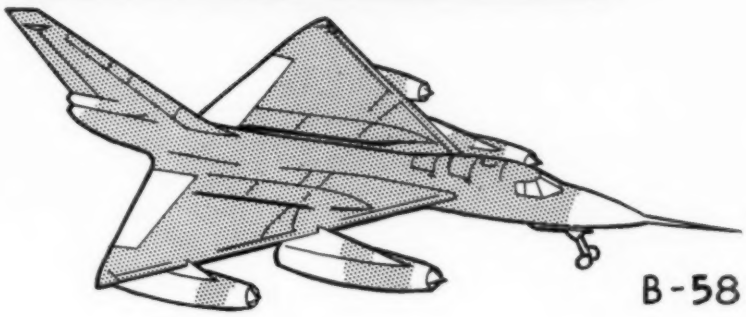
Another condition to be encountered by space-return vehicles is that of meteorite erosion from high speed contact with space particles. Recordings on U.S. satellites indicate that the influx of particles ten microns or above in diameter is not more than $10^{-3}/M^2/sec.$ and particles four or more microns in diameter about $10^{-2}/M^2/sec.$ However, the great speed in relation to a vehicle could cause considerable damage to exposed areas.

High vacuum may be a problem particularly on bonded sandwich composites. The trapped inside air will cause considerable pressure buildup inside the panels. This will vary with the interior volume of a panel. While it may not fail a panel alone, these stresses added to normal or abnormal loads may cause failure. Vented panels are subject to moisture pick up at low altitudes resulting in possible corrosion of internal parts.

Explosive decompression speaks for itself. It would cause extreme shock to all parts. Shock will also occur on dropping-off of stages, missile firing, etc. It seems at last that impact properties of bonded assemblies may become important.

Adhesive Bonded Sandwich Construction (1)

shaded areas



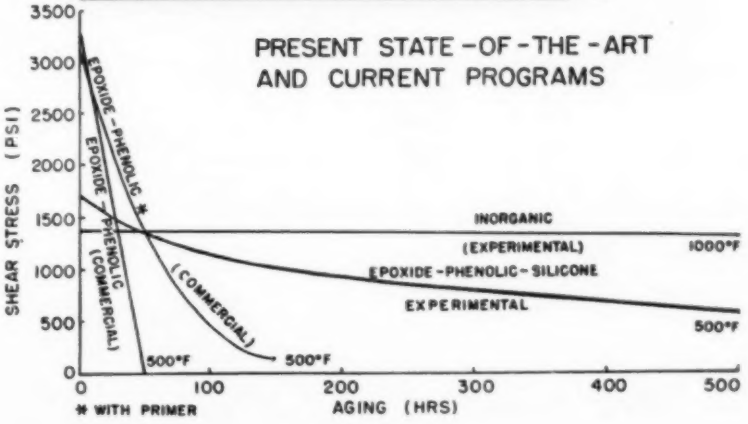
Solar radiation is an important consideration. It has been calculated that the complete spectrum of the sun will penetrate to 1,500,000 feet altitude. At 600,000 feet absorption will remove about half of the radiation in the 200 to 1000 A° range. At 200,000 feet none of the radiation in the 200—1000 A° range would be present and half of the radiation in the 1400—1800 A° range would be present and at 100,000 feet only radiations of wave lengths greater than 2000 A° would be present. About half of the incident radiation between 2000 and 3000 A° range would be present and radiations between 3000 and 3800 A° would be 25 per cent more intense than at sea level. Visible light, 3800 A°—7000 A° range, and infrared, greater than 7000 A°, would be practically the same at high altitudes as at sea level.

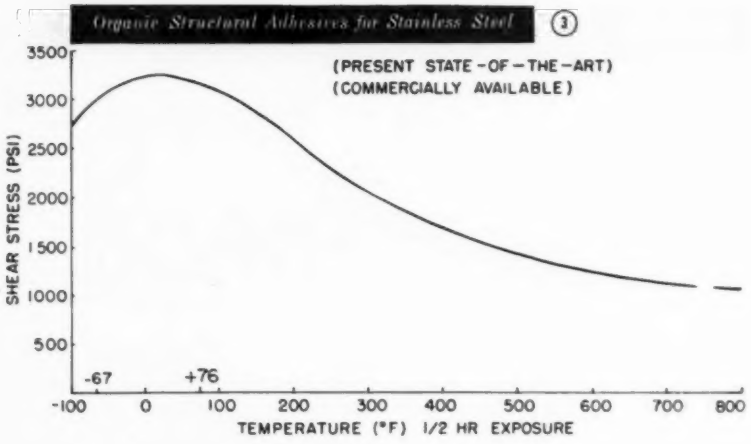
Effects of radiations, other than heating effects, are not considered a problem for most materials. While these conditions would deteriorate organic materials on outside surfaces, just as ultraviolet radiations do at sea level, inside structures would not be affected.

Allowance must be made for vibrations. At low altitudes sonic vibrations of a random nature between 30 and 10,000 cycles per second at intensities up to 190 db are expected. Sonic vibrations will not be effective at altitudes above 75,000 feet. Vibrations induced by power plants, aerodynamics effects, and unbalanced rotations will be present. It is indicated that fatigue may be severe at high altitudes due to the lack of air damping effects.

Ionized and dissociated gases could cause decomposition of bonds. Sampling shows that elemental oxygen and ozone are present to the extent of 7-11 parts per million at 70,000 to 110,000 feet elevation. Tests of adhesive bonds in a nitrogen atmosphere to exclude oxygen

Adhesive on Stainless Steel Aging Characteristics (2)





and in vacuum have indicated that oxygen deterioration is a very potent factor in thermal degradation of adhesives.

It is quite possible that our present organic adhesives can withstand much higher temperatures if oxygen is excluded from the bond. It is logical to assume that the considerably more active forms of oxygen would deteriorate bonds much more extensively than the normal oxygen of the air. Other gaseous conditions such as ionized oxides of nitrogen may also be troublesome.

Having considered these conditions, let's see what can be done about conquering them. First, we must bond or otherwise join metal alloys into composites of maximum strength with minimum weight. It has been calculated that a saving of one pound in the weight of a return vehicle will cut as much as 2000 pounds from the gross take-off weight of a multi-stage arrangement.

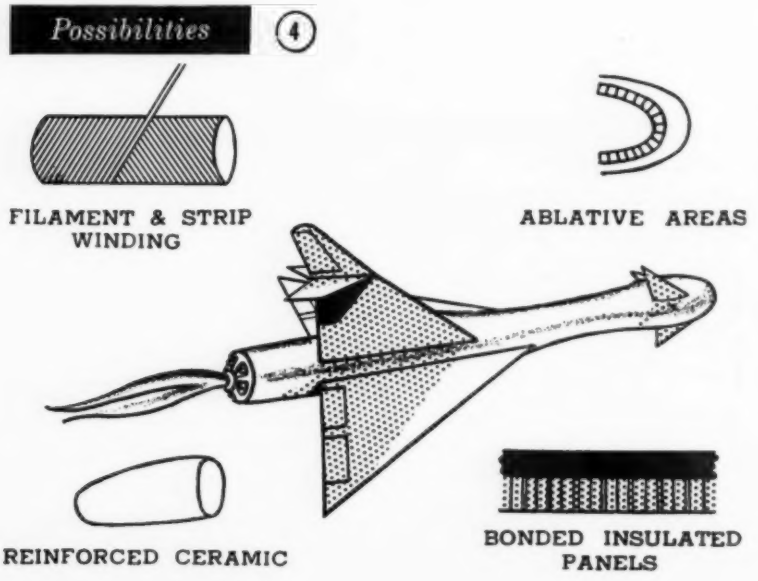
Provision must also be made to enable the structure to withstand the environmental conditions summarized. The most important factor here is heat. The metals people have been working very hard to develop high-strength, low-weight, high-temperature resistant alloys.

To date, practically all bonding has been done with aluminum and precipitation hardenable stainless steels. Adhesives or other methods of joining must be developed to bond the more resistant metals and alloys of metals such as beryllium, molybdenum, niobium, nickel, cobalt, tantalum and tungsten. These, and various types of ceramics, are the most promising base materials.

However, no one material will fill all the needs. They must be combined in composite structures in such a way that the limiting properties of some materials are supplemented by the superior properties of others.

A few of the many possible combinations include filament or strip wound structures bonded with suitable adhesive, ablation structures where the outside is vaporized, reinforced structures of many shapes, and complex sandwich composites incorporating insulation, refrigeration cooling. These composite structures are illustrated in Figure 4.

Previously mentioned adhesive qualities can play an important part in the perfection of composite structures in which materials of widely differing properties must be joined into structures that will be subjected to great temperature differences within small areas. It can be safely prophesied that adhesives are going to play a large part in our future flight vehicles. New bonding materials are now being developed that will perform under conditions that were considered impossible only a short time ago.



About the Author . . .

FLOYD H. BAIR is a project engineer on high temperature resistant adhesives and composite materials in the Materials Laboratory, Wright Air Development Center. He studied at State Teachers College (Indiana, Penna.), Duke University, Pennsylvania State University and Yale University. After teaching science subjects, he became an instructor in maintenance engineering in the Air Force Technical Schools. He started research and development work at the time structural adhesives were first developed.

Making

Polyethylene Adhesionable

By J. J. BIKERMAN
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A simple treatment renders polyethylene as "adhesionable" as any other substance.

To improve the adherence of commercial polyethylenes to solid surfaces, somewhat violent procedures such as flame-spraying of polyethylene (1) or spraying polyethylene dust on a metal heated (2) to 300-400°C. have been resorted to. Recently it was found in our laboratory that a simple treatment renders polyethylenes as "adhesionable" as any other substance. This observation is interesting in its own right, but more important is the fact that the above treatment was devised on the basis of a theory which points the way to a rational improvement of the adhesive properties of any substance.

According to the author's theory (3,4), when an adhesive joint is broken by mechanical means, a separation along the interface between two materials occurs so rarely that it does not need to be considered. Though on cursory inspection it sometimes appears that an interfacial splitting took place, a more thorough examination proves that some material from the adhesive remains attached to the adherend or some material from the adherend surface was broken off together with the adhesive. Thus, the rupture takes place across the adherend, the adhesive, or a boundary layer between the adhesive and the adherend.

Breaking Strength Of Joint

If the breaking stress of a joint is small compared with the breaking stress of the adherend or the adhesive, whichever is weaker, the presence of a weak boundary layer is highly probable. Weak boundary layers can originate in the adherend, in the adhesive, or in an interaction of these two materials. If an adhesive does not adhere to materials which can be glued with other adhesives, it is logical to conclude that the adhesive itself is the source of weak boundary layers. This is the case with polyethylenes.

The researcher's task then is to prevent the formation of the objectionable surface films on polyethylene. To guide him, an idea of what these films might be should be formulated.

Polyethylene melts are uniform and do not show any insoluble impurities. After solidification, however, surface films of a low mechanical strength should be present, if the above reasoning is correct. An effect of this kind is well known; in colloid chemistry it is denoted by the term syneresis.

A typical demonstration of syneresis would be carried out as follows. A polymer is dissolved in a hot liquid (a plasticizer or a solvent) to a perfectly clear and uniform solution. The solution is cooled. Gradually, separation in two phases takes place; one phase (a layer or a blob) contains practically the whole polymer and almost nothing of the liquid, and the other phase (a liquid imbibed by the polymer or a liquid layer) contains an almost pure solvent (or plasticizer). If the amount of the liquid is small, it is present as a thin film on the grains or gel particles of the polymer.

In the case of polyethylenes, the liquid impurities are likely to be short-chain polyethylenes and oxygenated compounds; the latter may be expected to be particularly insoluble in solid polyethylene.

Removal of low-molecular components from polyethylenes has been accomplished many times either by fractional precipitation or by extraction with solvents. The former method was used in the present work, and the following proved to be a convenient procedure.

Dissolve polyethylene in boiling cyclohexane or toluene or xylene and pour the hot solution into acetone or methyl ethyl ketone. Filter as soon as possible through several layers of filter paper, with suction. Dry the solid between filter paper sheets in air at room temperature.

The exact procedure depends on the initial polyethylene. Polyethylene wax, such as "Epolene N," can be dissolved in ten parts of boiling cyclohexane and is preferably precipitated in boiling acetone (ten parts). Polyethylenes of high molecular weight need about 15 parts of boiling toluene for complete dissolution, and precipitation is achieved by 20 parts of (cold) acetone.

Qualitative Adherence Test

A qualitative test for adherence consists in melting a grain of polyethylene on a solid, permitting it to solidify on cooling, and prying it loose with a knife. Many commercial polyethylenes are easily pried off. After the above treatment, the solidified drops of the same material cannot be cleanly pried or scraped off as long as the solid has no weak boundary layer of its own.

In butt joints, a commercial polyethylene (still solidified from melt) may show a breaking stress less than one-tenth the breaking stress of the

material in bulk. After the above treatment, the breaking stress of joints between steel and steel, steel and glass, and glass and glass, is greater than the tensile strength of the polyethylene used, the latter being tested in specimens about 5 cm. (2″) long. Thus, thin polyethylene joints had breaking stresses between 2000 and 3000 psi (140 and 210 bars) when the same material in bulk had a tensile strength of 1300 psi (90 bars).

When a commercial polyethylene is molten and then solidifies between an aluminum foil and a glass plate, the foil often can be peeled off at a very small load. When this experiment is repeated with an "adhesionable" polyethylene, the peeling force usually is almost as great as that calculated from the tensile strength of the adhesive (5). Peeling tension often exceeds one million dynes per centimeter (equivalent to 91 ounces per inch).

The statements made in the two preceding paragraphs are based on numerous experiments (their results will be published elsewhere). The other properties of "adhesionable" polyethylenes were investigated less thoroughly. Still, the following conclusions from the experiments in our and other laboratories seem to be warranted:

1) The tensile strength and the stress-strain curve are not drastically affected by the removal of the low-molecular and oxygenated impurities.

2) The melting range also is not significantly altered.

3) Printing ink impressions on treated polyethylenes are more durable than those on commercial materials.

4) The infrared spectrum shows small but revealing changes. If the initial polyethylene contains so many carbonyl groups that they can be detected by the 5.8 micron line, the line disappears after treatment. The absorption at 7.3 micron, which is caused by methyl groups, is weaker in the treated than in the untreated sample, indicating that the treated material contains fewer end groups, *i.e.*, fewer short and/or branched molecules.

The samples used for the infrared study were prepared by melting a calculated amount of polyethylene between two aluminum foils, cooling, and dissolving the aluminum in dilute caustic soda. In this way, the absence of oxygen-containing groups was established on specimens which were treated very similarly to those used for peeling tests (see above). This is important as otherwise it might have been suggested that the heating of polyethylenes (during the preparation of joints) caused its oxidation, and oxidation caused adherence.

5) The contact angle at the three-phase line of polyethylene, water and air is almost identical for a commercial and an "adhesionable" polyethylene. When a metal foil coated with raw "Epolene N" was gradually pushed in or pulled out of water, therefore, the advancing contact angle was 110° or 113° (in two independent experiments) and the receding angle was 98° and 100°, respectively; if the mean of the two angles is considered to be equal to the equilibrium contact angle θ, this was 104° and 106.5° in the two experiments.

When treated "Epolene N" was used instead of the commercial material, the advancing angle was 110° or 104°, the receding angle 98° or 94°, and θ was 104° and 99° in two experiments. Thus, the difference in the adherence between commercial and "adhesionable" polyethylenes is not likely to be due to a difference in their surface properties.

Cleanliness Important

When treated polyethylene is used as an adhesive, particular attention should be given to the cleanness of the adherend surfaces. It is known that polyethylenes are not soluble at room temperature in any liquid. In addition, apparently no liquid is markedly soluble in polyethylenes in the cold. Thus, any non-volatile liquid may act as a weak boundary layer at a polyethylene-adherend interface.

Such a liquid must be removed before a joint is made. In many instances, polishing a metal with an aqueous suspension of alumina and following this by a vapor degreasing with toluene, was found satisfactory. Polishing with an abrasive paper may contaminate the metal surface with the abrasive and the binder in the paper, and this contamination will not be removed by solvents.

The work reported above was sponsored by Lord Manufacturing Company, of Erie, Pennsylvania, represented by Mr. D. M. Alstadt.

Samples of polyethylene were donated by Eastman Chemical Products, Inc.; Semel-Solvay Petrochemical Division (Allied Chemical & Dye Corp.); Koppers Company, Inc.; and Shell Chemical Corp. The two first-named companies as well as Dewey & Almy Chemical Co. (W. R. Grace & Co.) and du Pont de Nemours & Co. carried out determinations of the infrared spectra. Aluminum Co. of America, Reynolds Metals Co., and Renard of Connecticut, Inc. donated aluminum foil.

The help given by Professor A. G. H. Dietz and his group was invaluable.

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About the Author . . .

JACOB J. BIKERMAN was born in Odessa, Russia, and was graduated from the University of Petrograd. Prior to coming to the U.S. in 1945, he held a number of industrial and academic appointments in Russia, Germany and Great Britain. He became interested in adhesion while director of research at Glass Fibres Ltd., Glasgow, Scotland. The usual theory of molecular adhesion did not appear convincing to him, and his lack of confidence for this theory intensified when his experience broadened during his activity as leader of the Adhesives Group, Printing & Allied Trades Research Association in London, England. He is the author of *Surface Chemistry* (1958) and *Foams* (1953) and is preparing a monograph on "The Science of Adhesive Joints." At present, Mr. Bikerman is supervisor of the Adhesives Laboratory at the Massachusetts Institute of Technology.

Speeding the Output of Pressure-Sensitive Tapes

Electronically controlled facilities for the fabrication of adhesives, pressure-sensitive tapes and allied rubber products became a production reality with the opening of Johns-Manville's new Dutch Brand plant in Chicago. The automatic system of manufacture utilizes the latest mixing, coating, slitting and combining equipment now available to the industry.

Equipment layout was designed by the Methods Engineering Section of the J-M General Engineering Dept., based on production specifications of the Dutch Brand Division. The cooperation of the J-M Research Organization and various equipment manufacturers was obtained.

Specifications for each piece of equipment call for great flexibility in its operation to permit fabrication of a wide variety of tapes and adhesives within the production cycle, and to create facilities for the custom-engineered manufacture of other items.

Offering approximately 100,000 square feet of production area, the single-story straight-line layout of the new plant permits the flow of materials directly from a mixing room on the north side to a shipping area on the south side.

The coating equipment, built to J-M specifications by the Frank Egan Co., is electrically controlled and operated with application settings as fine as 3/10,000 of an inch. Capable of coating 48-inch and 60-inch wide webs at a speed of 40 yards per minute, the release coater is of the print roll, two-temperature-zone type with an over-all oven length of 70 feet.

Also of the print roll type is the Anchor Coater capable of coating 48-inch and 60-inch wide webs at a speed of 40 yards each minute. A 40-foot oven is provided for drying in a single temperature zone.

A new Adhesive Coater is supplied with two coating heads: one of the reverse roll type, a second of the knife over-roll type. Both heads are electronically controlled and are designed for interchangeable operation. Three temperature oven zones provide 120 feet of drying area. In addition, the Coater has a 20-foot refrigeration zone.

All coating lines are equipped with safety controlled motor drives synchronized to the main electronic control panels.

After coating to specification, the base materials are transferred to the slitting room for winding on designated cores. Here, air conditioning provides the necessary temperature and humidity control required in the cutting and winding of the more advanced types of tape.

Depending upon the type and specifications of the tape manufactured, slitting of the coated base materials is accomplished on both rotary-knife slitters and slicing-cutters. Specially designed and custom-engineered tapes are cut and wound on an electronically controlled Dusenbery Slitter which allows for special tension settings and speeds.

After the above operation, finished tape products are ready for packaging and shipping.

The new plant also boasts a unique "Combining" unit designed to laminate parallel strands of organic or synthetic materials on flexible sheets. In this process, various materials such as paper, plastic films, etc., are bonded under pressure to fine strands of yarn ranging from as few as 12 or as many as 100 parallel strands per inch.

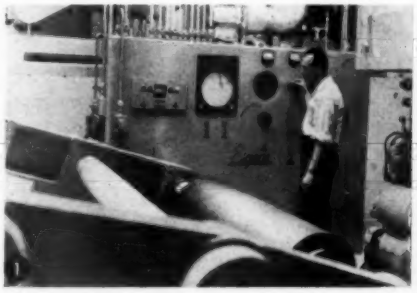


FIG. 1—Electronic control panels govern all coating equipment operations at the new Dutch Brand plant.

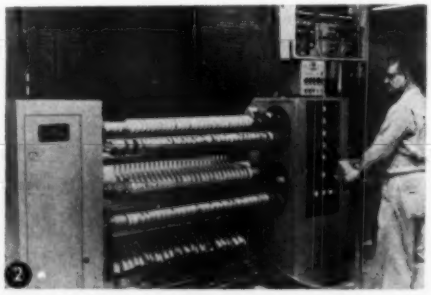


FIG. 2—Dusenbery Slitter can be set to automatically provide special tension settings and speeds.

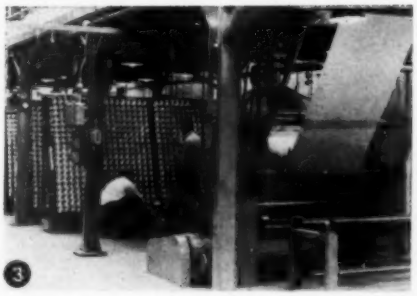


FIG. 3—Combining unit has 4000 spools, each with a capacity of from 15,000 to 25,000 yards.

FIG. 4—Finished tapes are speeded through packaging by an automatically controlled Wrap-King.

How to Laminate

Wood Structural Members

Because adhesives now available make the lamination process almost independent of temperature or moisture extremes, great strides have been made in the field, and the use of laminated wood structural members is rapidly increasing. Wood keels for small ships, cross arms for telephone poles, roof trusses and rafters, helicopter and airplane structural components, and stringers for highway or railway bridges—all fall into a category allowing production through use of wood laminae.

It is quite possible that development of other adhesives in the future will further extend this trend. For example, though the stability and other advantages gained from laminating make the process well worth while, at present the cost on laminated timbers and other laminated wood structural members runs fairly high. The savings inherent in the potential development of lower-cost adhesives which work equally well might cause a radical alteration of future costs.

In line with this, it might be pointed out that architects and engineers are continually on the alert to the possibility of lowering costs by incorporating into a laminate lower grades and species of wood. This in no way prejudices the overall strength of the product as there are certain places in a structural beam, for example, where the inherent strength of higher grade lumber is much more important than at others. This is particularly true where a straight horizontal beam is placed under load.

In such a case, compression and tensile stresses are at the top and bottom laminae of a built-up beam. Low-grade material to be used should be placed at the center of the beam and progressively better material should be used in succeeding laminae until highest quality layers are placed at the outside.

Inside vs. Outside Use

Obviously, the adhesives employed will depend on whether the laminated structural components are for inside or outside use. For example, where laminated components will be used under roof, casein glue can be employed to exceptionally good advantage. Kept cool and dry, such an adhesive will provide a good storage life. In addition, the length of casein glue's pot life allows plenty of time for clamping up members properly.

Generally, it is wise to use a scale for weighing both casein glue powder and the water used. An average mixture will contain approximately ten parts of casein glue powder to 18 to 20 parts of water by weight. Such glues cure chiefly through loss of water, and will always provide a satisfactory bond where moisture content of material is less than 15 per cent.

Mixing of casein glue is important and may depend on the mechanical mixer used. In the unit made by Black Brothers, for example, the adhesive powder is placed into a hopper at the top, and any lumps in the powder are broken up by means of a revolving spider. The glue powder then passes through a grating into a chute which delivers it gradually (and in finely-divided state) to the water in the mixing tank below. Design of the mixer is such that powder reaches the water near the outer edge of the mixing tank, where liquid velocity is greatest.

Casein glues can be used to good advantage even where temperatures are relatively low. However, they cure more rapidly if used at the average room temperature of 60 to 70° F.

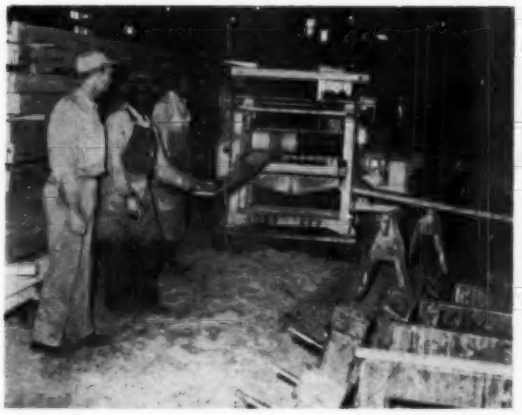
After casein glue has been mixed to a point where it takes on the general consistency of stiff dough, it is allowed to stand for a few minutes. Then, a chemical reaction occurs, allowing the mixture to go back to the consistency of cream. The adhesive is then stirred again for a short period, whereupon it smooths out nicely, ready for application.

Casein glues have a high lime content. This alkalinity gives them the characteristic of breaking down any oily film which may be present in

Scene of laminating plant interior shows a 2x12 board being passed through a heavy-duty glue spreader prior to being laid up in a forming jig.

pine or certain other woods and allows a better bond to be obtained. The same lime content, however, causes them to stain some woods to a certain degree.

Usually, some type of preservative is added to casein glue to render it immune from mold or fungus, by which it might otherwise be attacked. Such glue has good gap-filling properties, when a relatively heavy spread is applied. However, it is always wise to dress laminations for structural wood components as smoothly as possible, so as few gaps as possible will require filling. In cases where it is known that moisture content of the bonded wood will not exceed 20 per cent at any point, no preservative need be added to the mix; moisture content lower than this will seldom allow decay fungi to grow.



View of spreader unit's outfeed side as board with top and bottom glue application moves through the machine at approximately 180 lineal feet per minute.

Phenols and Resorcinols

Among resin glues, the phenols and resorcinols are chiefly valuable for lamination of structural wood components. Urea adhesive does not provide sufficient resistance to a great enough temperature or moisture range. Straight phenol-formaldehyde glue, while used to some extent because of its comparatively low cost, requires higher temperatures for curing properly.

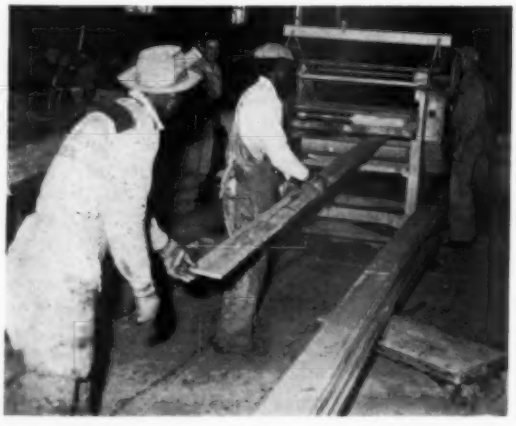
In most cases, therefore, either a straight resorcinol glue or a phenol-resorcinol combination is employed. Resorcinol has a different reaction, and has great specific advantage where it is desirable to make waterproof bonds comparable to those obtained with phenol adhesives—without, however, resorting to high-temperature curing.

Resorcinol is therefore highly favored for marine applications. For example, in the gluing of laminated oak keels for small ships the material bonded is too thick to hope for penetration of ordinary heat to the glue lines. Combined bending and laminating of such keels, like much other curved work, must proceed at a slow pace, in order to do a practical job. However, curing of resorcinol glue can be speeded by application of heat, and it sometimes happens that a given portion of a large structure being laminated may be subject to economic application of high-frequency heat.

This is particularly true any time that setting of glue on a given part would otherwise be considerably behind the rest of the assembly. Resorcinol glue is usually obtained in liquid form and used in connection with a catalyst, curing by chemical reaction. Variations are made in constituents, depending on conditions at the place where used. The same thing is true in general of phenol-resorcinol mixes.

High quality in laminated-lumber components is strongly contingent on two mechanical factors. One of these is the degree of flatness in laminae when they are actually spread and assembled; the other is employment of good glue-spreading technique, possible only through use of proper spreading equipment.

Two things must be held in view in achieving the highest possible degree of flatness in laminae being assembled. One of these is use of a modern planer, which will do a really smooth, accurate job of planing. The second flatness factor depends upon the material being spread and clamped as soon as possible after planing.



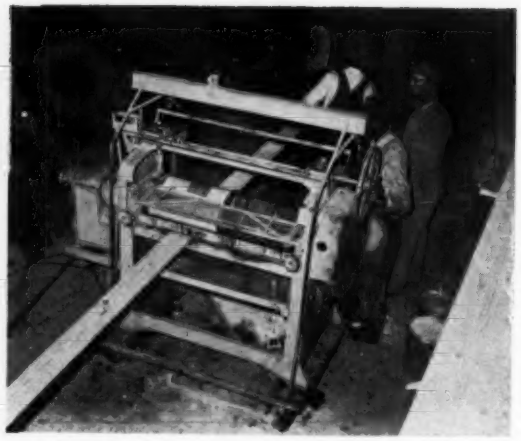
Dam arranged in top roll crotch which serves as a glue reservoir makes for dry left side of top roll assembly. Note glove on handlers.

Absolute Flatness Unattainable

Regardless of how flatly stock may be dressed, it will not *retain* absolute flatness if allowed to lay around for any considerable length of time after dressing. Wood is a hygroscopic material. It gives off moisture to the surrounding atmosphere, or takes on moisture, depending on conditions of humidity and the particular moisture content of the wood.

In either case, wood absolutely never gives off or takes on moisture at a precisely-uniform rate over its entire surface, with the result that slight shrinkage or swelling will occur in a "patchy" manner. In this way, the wood inevitably loses the perfect flatness it may have had only a short time previous. Therefore, gaps inevitably develop when any appreciable amount of time is allowed to elapse between planing, spreading and pressing.

Proper glue-spreading technique often involves employment of a heavier-than-ordinary mechanical glue spreader, if best results are to be achieved. Some leading glue spreader manufacturers, like Black Brothers Co., have developed heavy-duty machines especially built for lumber laminating. Not only do these units incorporate additional weight,



By keeping right side of top roll assembly dry, the board is run through for glue application on the bottom only. Camera is on unit's infeed side.

so they will do good work under the heavier strain involved in spreading heavier-than-ordinary material, but they incorporate a special upper-roll dam.

Where structural members are being laminated from lumber, best practice always involves spreading both sides of each ply—except, of course, that it is necessary to keep glue off the outside faces of outside laminae. In this way, a double-glue-line interface is provided between each two plies. While there are cases where single glue lines are used between plies, it is highly desirable in most instances to use a glue spread on all contacting surfaces.

Removable Dam Arrangement

The heavy duty glue spreaders described have a removable dam arrangement, by means of which adhesive is confined to only half the top roll reservoir, or to half the width of the spreader, so far as the top application roll is concerned. This means that half the length of the top application roll remains dry. Laminae to be spread on both sides are simply passed through between the rolls on that side of the spreader where the top roll dam is not effective. As often as a board for the outside of the structural member comes to hand, it is passed through the machine on the dry-roll side, thereby receiving a glue spread on one side only, from the bottom application roll.

Generally, spreaders of this type have a variable-speed drive, so material can be processed between the rolls at any desirable speed, depending on size and class of work being handled. The application rolls have a synthetic rubber covering, making them resilient, so they conform to any slight irregularities in lumber as it passes through, providing a uniform spread. Roll surfaces are grooved, so they will carry and apply a proper film of adhesive to the stock. The top roll can be adjusted, to leave any desired opening between the application rolls, for spreading different thicknesses of stock as need may arise.

Each of the two application rolls has a mating doctor roll, as it is called, which serves to meter or control thickness of glue allowed to stand on the application roll as it contacts the stock. The doctor rolls are provided with a highly sensitive adjustment, relative to distance between them and the application rolls. To control the glue film accurately, clearance between application and doctor rolls must often be set within a thousandth of an inch of desired position and this adjustment held without wavering.

Optimum temperature conditions vary with the different types of work being done and with specific adhesives employed. Casein glue makes a good joint even in a chilly location, and many like to employ this glue on laminated work, provided it is acceptable from other standpoints. Where resorcinol is used to laminate oak for marine work, it is usually found best to maintain a higher temperature than is used for various other woods.

In some lumber laminating plants where a glue spreader incorporating a top roll dam has not as yet been installed, it is possible to avoid getting adhesive on outer surfaces of outer plies by adjusting the roll, placing outer plies face to face, and running them through the spreader together. By this means, a single spread is obtained on each of the two pieces, but time is obviously lost because of frequent adjustments which must be made to spreader rolls.

It is also possible to obtain glue spreaders built to spread one side of the stock only. Therefore, by using two separate machines, the same general purpose can be served. However, this calls for a greater investment, in addition to unnecessary loss of time.

In some instances, spreaders of particularly heavy type have been designed for use with extra heavy lumber laminae such as long 2 x 10 or 2 x 12 components. Such machines are provided with a three-horsepower variable speed motor drive. This drive will provide any feed speed desired from a low of 60 to a high of 180 lineal feet per minute.

It will be observed from the pictures that spreader off-bearers are wearing gloves. This is because the formaldehyde contained in resin glues is hard on human skin. Reacting with protein contained in the skin, formaldehyde may produce a hard-scale type of skin eruption, and cracks in the skin may follow. As with most types of skin troubles, some men are far more sensitive to formaldehyde than others.

Those who persistently have such trouble are perhaps better transferred to duties which do not involve handling glues with a formaldehyde content. Otherwise, a permanent case of dermatitis may result. Most men find, however, that an ordinary amount of precaution protects them against such trouble adequately. If glue is handled carefully, rather than being spilled and slopped around, there is less chance of it coming into frequent contact with the skin. Careful handling is therefore helpful, both as an economy and a precautionary measure.

Emptying Glue Drums

Drums of resin glue can be emptied without spilling them if a suitable amount of care is employed. Measuring containers may be of a type which allow fast transfer of resin and catalysts so that the material will be in contact with the skin no longer than necessary.

Men working behind the spreader, actually handling veneers and plies spread with resin glues, should either use some kind of protective cream on the hands, or wear rubber gloves. They should also be encouraged to wash their hands frequently. Washing facilities installed close to the opera-

tion are a great help. A man who bathes thoroughly each day and changes his clothing frequently is far less liable to be affected.

Liability of men to contact skin trouble from formaldehyde in resin adhesives is no doubt heightened by the fact that because the temperature in a glue room is somewhat higher than in usual places, they are liable to perspire more as a result.

Some resin glues do not have the proper degree of chemical hardening at temperatures below 70° F. If the temperature is held directly at that point, there is the danger that it will fall below at some time and cause poor bonds.

As a safety factor, therefore, many glue rooms do not allow temperature to go below 75°F. and some operate through the range of 75 to 85°F. Obviously, in any case where glue rooms are held at these relatively high temperatures, many men perspire quite freely.

Clamping methods and facilities may undoubtedly be considered as the chief "bottleneck" in the lumber-laminating industries. Varying sizes of cross-section on given laminated beams—together with curves incorporated and other aspects which complicate application of proper clamping pressure—have made it necessary to keep a large array of forms on hand, as well as a tremendous number of bolts and other auxiliaries. Some progress toward better clamping facilities has been made, but there is still room for great improvement in this direction in the future.

One reason for maintenance of relatively high temperature in lumber-laminating plants is that the curing period in the clamps can be shortened when temperature is elevated to some extent. The amount of curing time allowed in the clamps must obviously be based on what is required for properly curing the center-most glue line.

High-frequency curing is used to some extent, but generally only in cases where one specific part of a component would otherwise require an inordinately great length of time in the clamps. However, high-frequency curing can be used at fairly moderate cost in preliminary gluing of scarfed joints in individual plies, and is considerably employed in this particular part of the work.

In addition, it can sometimes be used advantageously for gluing relatively small structural members, particularly when the electrodes of the high-frequency apparatus can be applied perpendicularly to the glue lines. In this way, the larger part of the high-frequency current localizes at the glue lines, where moisture is present, effecting a cure much more rapidly.

High-Frequency Equipment

Melamine adhesives work to high advantage with high-frequency equipment, and they are often employed in preliminary bonding of scarfed joints in individual plies. Almost never are these adhesives used for final laminating, however.

Development and fast increase of the use of laminated structural wood members has greatly changed the timber picture as a whole. Once, large amounts of square timbers were cut directly from logs at the sawmill, and were much employed in construction of mill buildings, etc. The larger use of steel in factory-building construction caused an initial down-trend in production of solid timbers; the fast upswing of laminated structural wood members has reduced the market for solid timbers still further.

Graceful curves can readily be incorporated in laminated wood structural members. This fact has set the architect and engineer free from straight-line design, even though special production problems have been imposed. Among these are pressure treating problems.

It is practical either to preliminarily treat timber laminae by pressure with chemicals and subsequently glue them together, or to first glue up timbers and pressure treat them with preservative afterward.

However, pressure treatment of wood is handled in a long, large-diameter steel drum and many laminated members of curved form cannot be placed in a pressure retort after lamination. Consequently, where laminae are to be used in curved members, it is necessary that pressure treatment precede lamination.

In instances where laminated members are straight, it is usually found best to treat them after they have been glued together. Obviously, since pressure treated members are often exposed to weather, adhesives which are proof against high water content should be used.

Subsequent timber sizing must also be considered when dealing with curved laminated structural members. It is evident that standard timber-sizing machines employed on solid timbers cannot be used for final sizing of laminated timbers. Nevertheless, it is interesting to observe that at least one manufacturer of timber-sizing machinery is working on a unit with an exceptionally long cutterhead which will allow sizing curved laminated timbers.

Adhesive Bonding of Audio Components

A fast-setting adhesive has helped Electro-Voice, Inc., Buchanan, Mich., solve a critical problem in the assembly of its newest Power Point miniaturized phonograph cartridge. The use of adhesive bonding to join the unit's basic components is enabling the company to maintain the tight scheduling demanded by a production line operated in conjunction with a conveyor system.

The Power Point represents a radically different approach towards the replacement of high-fidelity needles in better quality audio systems. It involves the substitution of worn units with a complete new cartridge having integral jeweled points.

The design of Electro-Voice's new cartridge is such that fast assembly techniques based on the use of an adhesive enable it to be sold at prices competitive with conventional needles alone.

In assembling the three basic parts, a plastic boot is slipped over the ceramic element holding the jeweled points. A nylon case is then fitted over these. The assembler then applies Eastman 910 Adhesive which flows down between the three parts and bonds them together.

Adhering Dacron to Rubber

Part 1 — The Research Approach

Du Pont chemists describe the use of blocked-isocyanates in aqueous media

By W. L. THOMPSON, T. B. MARSHALL & A. T. SWEET

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To fully evaluate the use of Dacron polyester fiber in rubber goods, a better means of obtaining adhesion to rubber was necessary. Though the resorcinol-formaldehyde-latex (RFL) adhesive is well suited for adhering nylon and rayon to rubber, it is borderline to inadequate for Dacron adhesion.

In some cases, the uses of Dacron have been considerably hindered by its poor adhesion to rubber. Nevertheless, the high modulus, dimensional stability, strength and chemical and thermal stability of this fiber have made it an interesting rubber reinforcing material.

The first half of this two-part article describes the use of blocked-isocyanates in aqueous media for adhering Dacron to rubber. From these studies an aqueous adhesive called D-15 was developed which has shown considerable promise for use in building Dacron reinforced rubber articles such as corded V-belts. This adhesive preparation is composed of phenol-blocked diphenylmethane diisocyanate dispersed in butadiene-vinylpyridine-styrene latex.

In developing an improved Dacron-rubber adhesive several requirements were considered. The adhesive system must be aqueous, yield high static and dynamic adhesions, be relatively inexpensive, and have low toxicity. These requirements would probably be considered for most fiber to rubber adhesives in general.

Two additional requirements had to be recognized in our work. Dacron corded structures must be hot stretched at 220°C. for approximately sixty to ninety seconds to develop optimum cord properties. Since simultaneous cord-stretching and dip-curing are highly desired for economical reasons, it was important that any adhesive so developed cured best under these conditions.

Finally, it was important that the adhesive have little effect upon cord properties. Sacrifice in static or dynamic behavior of the cords brought on by the adhesive could render the fiber unsuitable for many uses.

Table I—Composition of Rubber Stocks

	Parts by Weight
Smoked Sheet	40
GR-S 1000	40
Midco B	40
RPA No. 5	0.35
Zinc Oxide	3
Furnex Carbon Black	30
Pine Tar	2
Akroflex CD	1
Stearic Acid	2
MBTS	0.7
DPG	0.15
Sulfur	2.8

Figure I—Typical Blocking-Unblocking Reaction

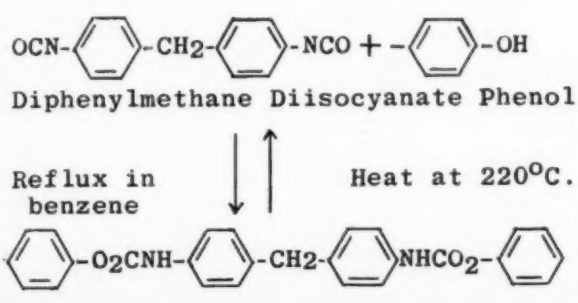
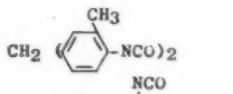
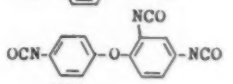
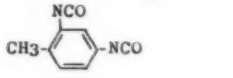
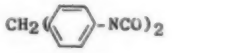
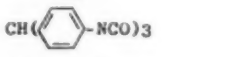


Table II—Dacron-Rubber Adhesion with Isocyanate-Rubber Cements Dips as a Function of Temperature

Item	Isocyanate Structure	Cord Strip Adhesion, Lbs. at Indicated Adhesive Curing Temp. 160°C	180°	200°	220°
1		3.0	3.3	4.2	2.6
2		1.9	2.3	2.7	1.4
3		0.51	0.7	2.8	1.8
4		4.4	3.4	2.3	1.5
5		2.3	0.8	0.7	0.5
Control 6	No isocyanate				0.2

All tests were carried out on 1900 denier Dacron industrial cords of 220/4/2 construction. Adhesive dipping and curing was accomplished on a single end machine built by the W. M. Steele Co. (1). The machine was modified to include a predrying oven having an outside air exhaust to minimize fire and explosion hazards when flammable dip solvents were used.

Blocked-isocyanate dips were prepared by ball-milling the blocked isocyanates in water with a wetting agent. The dispersion was stabilized with about one per cent sodium alginate, and sufficient latex was added to give a latex solids/blocked-isocyanate ratio of 1/1. The latex used was butadiene-vinylpyridine-styrene (70/15/15) unless otherwise indicated.

Dissolving Tests

Isocyanate dips were evaluated by dissolving the test isocyanate in rubber cements for cord application. Dip curing was accomplished by heating 220°C. for 60 seconds unless otherwise indicated.

For initial scouting purposes only static adhesion was measured by the single end cord strip test. Dipped cords were placed 0.5 inch apart on a rubber slab (Table I) of 5/32 x 5 x 11 inches reinforced with 8-ounce cotton duck.

This assembly was vulcanized in a mold at 145°C. and 175 lbs. psi for 45 minutes so that the test cords became imbedded just below the surface of the stock. The individual cord specimens were peeled in an Instron tester at room temperature using a crosshead speed of two inches per minute. Four specimens were used per test item and each was peeled three inches. An adhesion value of four pounds per end by this test was considered an excellent result.

The bonding of fibers to rubber by means of isocyanates mixed with rubber cements in organic solvents has been known for several years (2 and 9). With the proper choice of the isocyanate and curing conditions excellent adhesion levels can be obtained. Adhesion values obtained during this work with some typical isocyanate structures have been listed in Table II.

However, in many applications, an aqueous system is desirable, and the use of hydrolytically stable isocyanates would have many advantages.

Isocyanate Regenerated

The early literature (3) referred to the fact that some adducts of isocyanates with active hydrogen compounds regenerated the original isocyanate upon heating. Thus, as shown in Figure 1, reaction of diphenylmethane diisocyanate with phenol produced the adduct which is used in D-15 adhesive. Heating of this adduct in the vicinity of 220°C. regenerated the isocyanate. The active hydrogen compound is often referred to as a "blocking agent" and the adduct as a "blocked-isocyanate."

Many of these blocked-isocyanates are hydrolytically stable. Thus, this behavior should permit the use of "blocked-isocyanates" in aqueous systems for application to fibers, and the curing step should be suitable to cause formation of an

Table III—Adhesion with Phenol-Blocked Isocyanates Dispersed in Vinylpyridine Latex

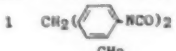
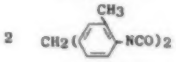
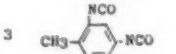
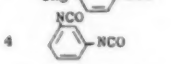
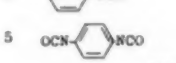
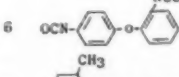
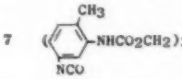
Item	Isocyanate Structure Before Blocking	Tire Cord Strip Adhesion With Phenol-Blocked Isocyanate Pounds/End
1		4 to 5
2		0.5
3		0.5
4		3
5		0.5
6		5
7		4.5
8		0.5
9	RFL Dipped Control	0.8 to 1.0

Table IV—Adhesion with Diphenylmethane Diisocyanate Blocked with Various Agents

Blocking Agent	*Tire Cord Strip Adhesion-Pounds/End*
Diethyl Malonate	0.5
Ethyl Acetoacetate	0.5
Acetone Oxime	4 to 5
Phenol	4 to 5

isocyanate to yield a good adhesive. Our work was based upon this phenomenon.

The literature (4 and 5) has listed several compounds which have been briefly investigated as blocking agents. These were: hydrogen halides, phenols, thiols, oximes, sodium bisulfite, hydrogen cyanide, acetoacetic ester, malonic ester and isatin. It has been said (6) that "the more acid the hydrogen of the blocking agent the easier the splitting of the adduct on heating to regenerate the isocyanate."

Adducts of Polyisocyanates

The patent literature (7) has described adhesives for adhering rayon to rubber using the adducts of polyisocyanates with acetoacetic ester and malonic ester dispersed in a latex. Other workers (5) have claimed, however, that the adduct derived by reaction of methylene bis(4-phenylisocyanate) with malonic or acetoacetic ester cannot be used satisfactorily to bond nylon or polyester fibers to rubber. Possibly these adducts cleaved too slowly for use on these fibers.

Experiments carried out with several dispersed di- and tri-isocyanates blocked with phenol showed that the structure had a profound effect on adhesion. The results have been summarized in Table III. Some isocyanates which gave good adhesion when applied from rubber cements gave very poor adhesion in the blocked form. Items 2 and 3 in Table III were examples of this behavior.

The data also showed that seemingly small changes in structure could operate to change drastically the adhesion obtained. Blocked diphenylmethane diisocyanate (Item 1) gave a very high level of adhesion as demonstrated by tearing of the rubber stock when the test cords were pulled out. If a methyl group were put on the ring, as shown in item 2, poor adhesion resulted.

Items 3 and 4 behaved in a similar manner, with phenol-blocked *meta*-phenylene diisocyanate giving a near satisfactory level of adhesion whereas the 2,4-toluene diisocyanate adduct showed practically no adhesion at all.

The phenol blocked-isocyanates listed as Items 7 and 8 should evolve only phenol upon heating and form the triisocyanates as indicated. Item 7, which had a methyl group *para* to the phenol blocked-isocyanate group produced a strong adhesive bond. However, placing of the methyl group in the *ortho* position, as in Item 8, resulted in essentially no adhesion.

It would appear that the methyl group substituent operated to lower adhesion when it was in the *ortho* position as opposed to ring substitution at any point and probably did so by reducing the rate at which the adduct split. Comparison of phenol-blocked *para*-phenylene diisocyanate, which gave poor adhesion, with the *meta* isomer, which gave much greater adhesion, demonstrated that even the relative position of the isocyanate groups must be reckoned with.

It might be expected that triisocyanates by virtue of their cross linkability would form stronger adhesive bonds than diisocyanates. The experiments did not demonstrate this, but this could have been due to failure of the strip adhesion test to distinguish between very high levels of static adhesion.

Although at least three blocked-isocyanates were uncovered in this work (Items 1, 6, and 7; Table III) which gave excellent adhesion, phenol-blocked diphenylmethane diisocyanate was chosen because of its cheaper price and availability.

Of the many blocking agents claimed in the literature, the studies with diphenylmethane diisocyanate blocked with several blocking agents indicated that phenol and acetone oxime were the most practical. Some others did not regenerate at all or did not regenerate rapidly enough and others were too toxic or unsuited otherwise.

A Brief Investigation

The experiments also confirmed that the malonic and acetoacetic ester adducts of diphenylmethane diisocyanate referred to previously would not work on Dacron polyester fibers. Results have been listed in Table IV. Not shown in the table was the brief investigation of thiophenol as a blocking agent. Its adduct with diphenylmethane diisocyanate was applied from rubber cement. This adduct regenerated at a lower temperature (ca. 20 to 40°) than the phenol adduct and gave adhesion much in the same range.

The latex used in the blocked-isocyanate dips was as important as the blocked-isocyanate structure and the blocking agent in determining adhesion. The data summarized in Table V demonstrated that the butadiene/vinylpyridine/styrene latex gave outstanding adhesion values of 4.0 to 4.5 pounds. Butadiene/styrene and butadiene latices gave much lower values of 1.8 and 1.5 pounds respectively.

Strip adhesions with these two latices of approximately three pounds were obtainable but only if a curing temperature of approxi-

Table V—Effect of Latex Composition on Adhesion with Phenol-Blocked Diphenylmethane Diisocyanate

Latex	*Strip Adhesion—Lbs.*
Butadiene/vinylpyridine/styrene (70/15/15)	4.5
Butadiene/Styrene (70/30)	1.8
Neoprene	0.5
Butadiene	1.5

Table VI—Static Tensile Properties of Cords Dipped with D-15 Blocked Isocyanate Adhesive

	Breaking Strength		
	Pounds	*Mi*	*Elongation, %*
Hot Stretched Cord-No Dip	23.6	61.7	13.5
Dip-Stretch Cord	22.6	61.0	14.4

mately 190°C. was used. Neoprene latex gave the lowest value of all at 0.5 pound and 190°C. curing temperature resulted in only minor improvement.

Anchors Latex

The mechanism of the blocked-isocyanate adhesives for Dacron-rubber systems has not been elucidated, but it probably involves polymerization of the regenerated polyisocyanate which interacts to anchor the latex rubber to the polyester substrate. The latex rubber in turn would vulcanize to the skim stock.

With too much blocked-isocyanate in the dip it would be expected that latex rubber concentration in the cured dip would become too low for effective adhesive-to-rubber bonding. If the blocked isocyanate concentration were too low, a weakened bond between the fiber and adhesive would probably be observed.

Figure 2 shows the effect of varying the weight per cent of dip solids of phenol-blocked diphenylmethane diisocyanate in the dip. The extreme left hand portion of the adhesion curve represented bond failure on the fiber-adhesive side and the right hand portion represented adhesive-to-rubber failure.

Superimposed on this figure is a curve representing cord strength loss during flexing of the dipped cords which were imbedded at the surface of a CT tube (8) and were run for eight hours at 1550 C.P.M. Too much resin (blocked-isocyanate) in the dip caused high penetration of the cord bundle which resulted in stiff cords and high cord strength loss.

Compromise Formulation

A compromise in adhesion to reduce the cord strength loss resulted in a composition (arrow) showing only eight per cent cord strength loss and which still gave a very good level of adhesion. Physical properties of cords (Table VI) dipped and hot-stretched with the indicated composition were essentially the same as those of hot-stretched but undipped control items.

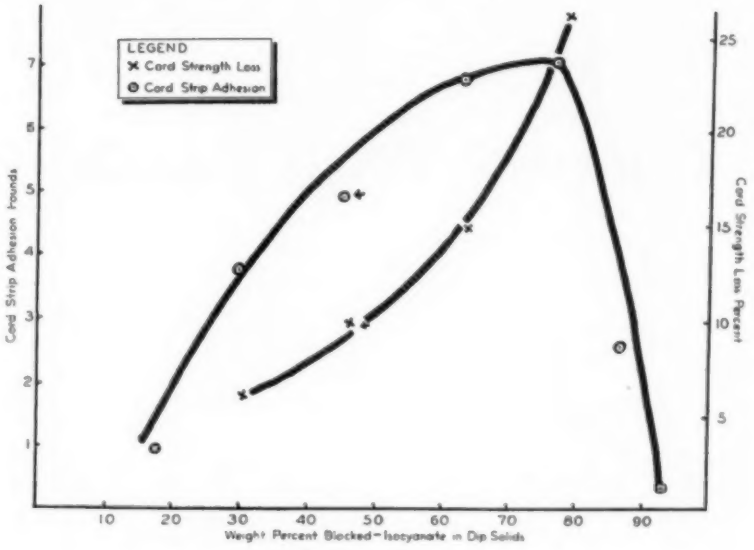
A systematic investigation of the variables controlling adhesion of Dacron polyester fiber to rubber using blocked-isocyanate dips led to the development of a greatly improved adhesive. This adhesive, coded D-15, gave four- to five-fold adhesion increase over RFL. It was based on phenol-blocked diphenylmethane diisocyanate dispersed in butadiene/vinylpyridine/styrene latex thickened with sodium alginate.

The latex composition and blocked-isocyanate structure were critical factors controlling adhesion. The blocked-isocyanate/latex ratio could be varied over a wide range without decreasing adhesion to an unacceptable level. However, adhesion and dynamic cord strength loss had to be balanced for best performance of adhesive dipped cords.

The adhesive appeared to have little effect on static properties of the fibers.

(Continued next month.)

Figure 2—Adhesion and Dynamic Cord Strength Loss as a Function of Phenol-Blocked Diphenylmethane Diisocyanate Content in Dip



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How To Select

Curtain Wall Caulking Sealants

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Sealing and weatherproofing curtain wall construction is a problem of prime importance and requires the closest cooperation possible among the architect, the builder or contractor, and the sealant manufacturer.

Among the questions that should be answered before starting a project are: How is the building face to be sealed? Will the design and sealing compensate for the greater dimensional changes that take place with the new types of curtain wall materials? What type sealant should be used? How much will the sealing cost? How long before the seal must be repaired? Does the sealant manufacturer accept the responsibility for providing a weatherproof joint?

The best of sealants will not adhere tightly to dirty, greasy, wet or oily surfaces for very long. It is therefore important that the joint be designed to permit easy accessibility for both cleaning and the sealant application. In addition, the design must be adequate for sealant space as well as cumulative expansion.

For example, if the design calls for a ⅛" layer of sealant in a joint where the maximum calculated movement would be ⅛", the material would be subjected to 100 per cent elongation. The same thickness of sealant in a joint of calculated movement of ½" would then be subjected to the much higher requirement of 400 per cent elongation.

Joint designs should allow for a minimum of ⅛" of sealant at all places. They should not taper to less than ⅛" because the elongation which a sealant is capable of tolerating depends on the thickness in the joint, and sealants in very thin sections may be stretched in service beyond their capabilities.

Often the same sealant used for the panels is used to set the glass. In general, it is recommended that in using stops or moldings, the glass or unit size should allow ¼" at the sill for blocking, 3/16" clearance at jamb and head for placement, and 5/32" space for sealant on either face. A prominent glass manufacturer recommends that the depth of the rabbet should be one and a half times the thickness of the glass plus a quarter of an inch. Spacer pads should be used on the face of the glass to insure the proper thickness of glazing material at all times. Avoid a quarter of an inch of material on one side and metal to glass contact on the other.

The function of the sealant is to weatherproof the joint regardless of the future dimensional changes and exposure conditions. Naturally, the design of the joint and its calculated movement should govern the choice of sealant. Conventional caulking compounds have proved satisfactory where the joint movement is small, or where the sealant would be unexposed and protected from direct sunlight, or where periodic maintenance is not an expensive item.

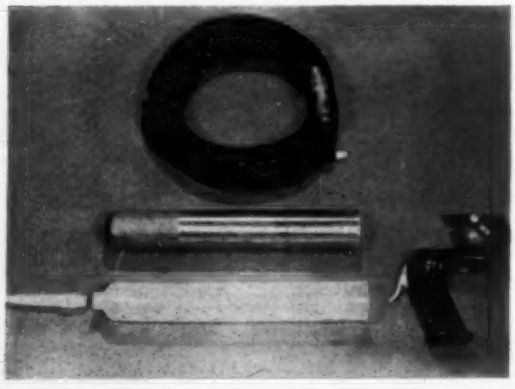


Figure 1—The mechanical extrusion gun shown here uses a polyethylene cartridge which can be prefilled with sealant.

Oil-Based Compounds

Oil-based caulking compounds are one-part systems which are inexpensive, easily handled, and show good adhesion to a wide variety of surfaces. Properly used, they have a life expectancy of from five to ten years. The polybutene sealants (tapes or beads) have excellent adhesion, are easily handled by inexperienced labor, and have a longer life expectancy than the oil-based types. Neoprene and vinyl-type gaskets can be used over the required temperature range; offer good resistance to sunlight, ozone, and oil; and have an estimated 20-year life expectancy.

The above mentioned sealants, however, have certain disadvantages which make for problems. For example, oil-base sealants tend to dry out and "crack away." They should be used only in joints where the expected elongation requirements would be below ten per cent. Polybutene tapes remain tacky after installation and can pick up dirt. In addition, because of their predetermined size, they reqiure rigid tol-

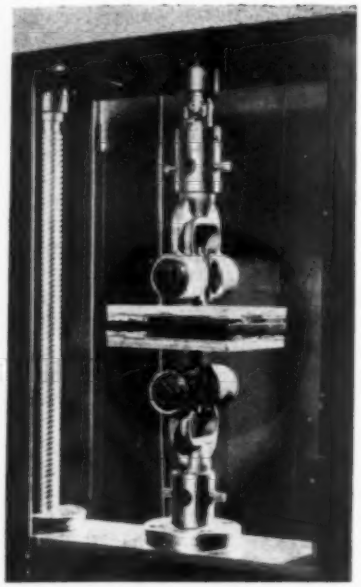


Figure 2—"Stretcher" type fatigue-adhesion test on butt-joined pieces of plate glass is used in preliminary evaluations of sealant.

erances in the joint design. The neoprene or vinyl gaskets require pressure stops to be held within very limited tolerances.

It can be readily seen that none of these sealants is a completely satisfactory solution and that all represent a compromise.

Sealants of the polysulfide type can be specially formulated and tailormade to meet the rigid requirements of increased flexibility, elongation, durability, etc. Accelerated heat aging, ultraviolet exposure tests, dynamic weather tests, and actual field installations indicate that these materials will perform satisfactorily under the most severe exposure conditions. They cure without shrinkage within the joint, retain their elastic and adhesion properties through a temperature range of from −65 to 250°F., and can be formulated to perform satisfactorily in joints requiring to 150 to 200 per cent elongation at temperatures as low as −30°F. Test results and installations indicate an estimated life expectancy of at least twenty years, maybe even as long as forty or fifty years.

Even polysulfide sealants have some undesirable properties. This type of sealant has a relatively high initial cost. Based on a ¼" bead the relative cost per foot would be approximately seven times that of a natural oleoresinous caulking compound. However, the expense of recaulking, including labor costs, scaffolding, etc., may well show that the more expensive compound is the best buy over the long run.

The materials are usually supplied as a two-part system. A one-part system would be more desirable and such a material may be developed with the high qualities of the present compound. The techniques and equipment necessary to handle such two-part systems will be discussed later.

On porous surfaces such as concrete, marble and granite, the use of a primer almost becomes a necessity to insure a long lasting seal. Used on these surfaces, a primer not only improves the bond of the sealant under conditions of excessive moisture, but also eliminates a potential staining problem.

The latter problem stems from the fact that the resin often used to improve the adhesion properties of polysulfide sealants contains a chemical which can migrate into masonry under wet conditions. The chemical eventually turns pink and discolors the face of the masonry in areas well removed from the area of the sealant. This can be prevented by using a primer.

Early in the design stage of the building, therefore, samples of the construction materials should be made available to the sealant manufacturer for test purposes. The designer and architect should have previously determined the performance requirements that must be met by the sealant.

Realistic assignments of responsibilities should be discussed at this time. Sealants that are haphazardly applied to unclean surfaces are hardly worth the room they take up. Competent supervision of the job's sealing phase is therefore a "must."

The sealant manufacturer will guarantee that his material meets the performance specifications set up, but he cannot guarantee the workmanship on the job. Because of the variables over which he has no control, it is extremely doubtful that a reliable manufacturer will be able to give any guarantee on the life expectancy of the seal.

As has been pointed out, while the project is still in the design stage, the sealant manufacturer should be in a position to offer assistance to the architect as to the type of sealant to be used and its applicability. In addition, he should make available on-the-job supervision capable of an answering the "how," "where," and the "why."

Polysulfide sealants are usually supplied as two-package systems consisting of the base material and a curing agent. The curing agent is usually a paste like suspension of lead dioxide in plasticiser and due to toxicity problems should be handled accordingly. The compounds are stable separately for six months when stored at 75°F., or below. Prolonged storage may change some of the properties such as cure time or application life, but should not affect the sealant's performance otherwise.

Prepared Compounds

The respective parts of the compound are usually supplied in the proper proportions, pre-weighed. Suitable mechanical mixing can be accomplished in the original containers, by using a standard ½" slow speed electric drill with a vertical sigma shaped blade. The speed of rotation should not be more than 150 rpm otherwise air may be entrapped in the mix.

In order to obtain the optimum properties from the compound it is very important that the two ingredients are thoroughly mixed. Mixing equipment such as that manufactured by the J. H. Day Company has been used satisfactorily. On some jobs the sealant is pre-mixed and frozen and

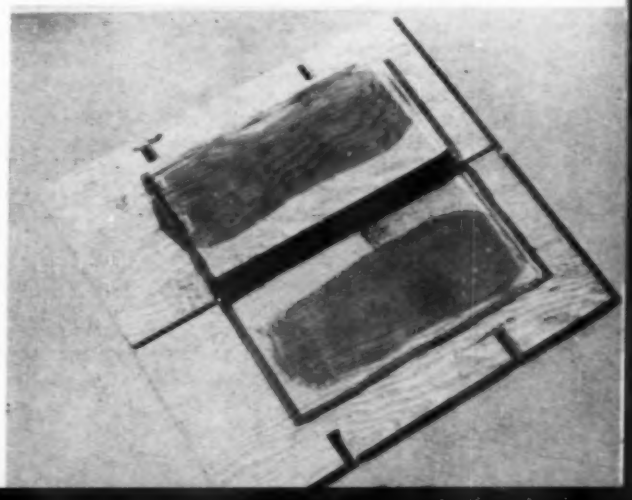


Figure 3—Water is trapped between glass by 5/16" bead of sealant. During the test, the sealant is alternately stretched and relaxed.

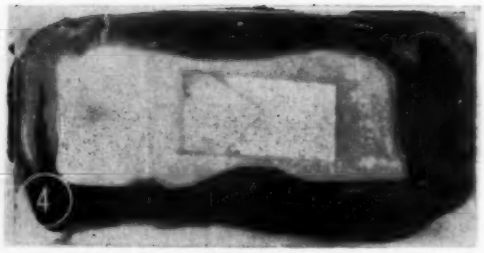


Figure 4—The effect of ultraviolet light on glass bonded to aluminum is shown. The sealant lost its adhesive qualities after 200 hours.

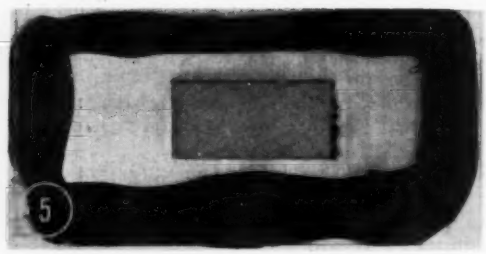


Figure 5—The same compound used with primed glass is shown after 1000 hours of exposure to ultraviolet light.

Figure 6—This specimen shows the effects of 1000 hours of exposure on a polysulfide sealant used with primed glass.

then supplied to the applicators. Proportioning mixers manufactured by the H. V. Hardman Company, Bell and Gossett Company, and Pyles Industries, will do a very thorough mixing job as well as evacuate the undesired air from the compound. However, they have not been a factor in the field as yet.

To obtain long lasting adhesion, sealant manufacturers recommend that surfaces involved be wiped with a clean cloth moistened with a solvent such as toluol or xylol. Masking the adjacent surfaces has proved to be economical.

The sealant may be applied either with a suitable manual caulking gun or with a mechanical extrusion gun such as the one manufactured by Pyles Industries. This gun (see Figure 1) uses a semi-rigid polyethylene cartridge which can be prefilled with the mixed sealant. It provides a convenient, efficient method for application where compressed air is available.

As mentioned previously those sealants can be tailor-compounded for almost any application. For example, the application life of the sealant can be varied from as low as thirty minutes to as long as several days at normal temperatures and humidities. Usually, unless other agreements have been made, the aplicator could expect about four hours application life, and the sealant would be tack-free in approximately forty-eight hours. An increase in temperature or relative humidity tends to decrease the application life and the tack-free time.

Test methods have been designed to measure the ability of the sealant to perform satisfactorily; that is, to retain the excellent adhesion properties, flexibility, durability, etc., after prolonged exposure to severe weather conditions and external movement.

Testing Procedures

Relatively simple tests can be used for preliminary evaluations. Figure 2 illustrates two pieces of ½" plate glass butt-joined with sealant (½" bead) and subjected to a "stretcher" type fatigue-adhesion test. The sealer is stretched .120" per day and then relaxed. This specimen can easily be placed in the oven for aging or can be mounted outside for weather exposure.

Figure 3 illustrates two plates of ¼" plate glass bonded to each other by a 5/16" bead of sealant around the periphery, entrapping water between the glass plates. The plates are pulled apart at 0.05" per minute until the sealant is stretched 0.125" and then relaxed. This sample also can be subjected to different temperature and cyclic conditions, outside exposure, etc., and then checked again. From these comparative tests the manufacturer can obtain data necessary for the successful formulation of the sealant.

Other surfaces such as aluminum, porcelainized steel and aluminum, galvanized steel, stainless steel, and masonry are certainly as important as glass in the curtain wall construction. The adhesion to aluminum can be checked by bonding two pieces of T-angle together with a ½" x ½" joint of sealant. The compound should be able to withstand 150 per cent elongation without failure. After aging at 158°F., it should be able to be extended 100 per cent without failure. The force required to produce these elongations should not exceed 60 psi. Other T-specimens are subjected to prolonged exposure of −20°F., and the sealant should be capable of being extended 100 per cent at this temperature without failure.

Checking Adhesion

The adhesion of the sealant to many surfaces may be checked by peeling duck cloth that has been bonded to the surface in question. The sealant should have a peel strength of 15 pounds per inch width after cure and at least 10 pounds per inch width after immersion in water for four days. The samples described above can be subjected to prolonged exposures in the weatherometer, the sunlamp, and in ultraviolet radiation and then retested to determine any deterioration.

Figures 4, 5, and 6 illustrate the effect of weatherometer exposure on samples of plate glass bonded to aluminum. The combination of ultraviolet light and water may cause a definite loss of adhesion between the sealant and the glass. In this particular test, the samples were arranged in the weatherometer with the glass surface facing the light. *The loss of adhesion only occurs when the ultraviolet light passes through the glass to the sealant.*

Figure 4 illustrates the effect of exposure on a compound having

relatively poor ultraviolet resistance. After 200 hours of exposure, the bond is almost completely gone. The same compound, tested in the weatherometer with glass that had been primed with Armstrong Cork J-1190 Primer, is shown in Figure 5 after 1000 hours exposure. Finally, Figure 6 shows a modified polysulfide sealant with primed glass after 1000 hours exposure.

Dynamic weather tests conducted on mock-up assemblies tend to point out the shortcomings of design, or construction, or flaws that can be remedied on the big job. The polysulfide sealants have been tested successfully in such installations where a fixed sealed window (4' x 8' x ¼") was subjected to the equivalent of 100 mph winds with four inches of rainfall per square foot of specimen frontal area. The window was also subjected to gusts of from 50 to 130 mph. The glass deflection at midpoint was ⅝" during this test.

All in all, these tests indicate that the polysulfide base sealants have some very desirable properties, and where top performance is required they seem to have the most to offer at the present time.

About the Author . . .

C. D. BARLET joined the Armstrong Cork Co. in 1955 as a chemical engineer in the Industrial Adhesives Section of the Research and Development Center in Lancaster, Penna. During his association with Armstrong he has helped evolve a number of new and improved products in the field of industrial adhesives and has delivered several papers on the subject before scientific and engineering societies. He graduated from Pennsylvania State University in 1951 with a B.S. degree in chemical engineering, and prior to joining Armstrong, he worked for General Electric in insulation research.

Serving as supports for the aluminum floor are "U" shaped structures of reinforced epoxy resin. They are bonded to the main beams of the aircraft on three-inch centers.

Epoxy Resins For Aircraft Insulation

Douglas Aircraft Co., Santa Monica, Calif., has provided an innovation in the DC-8's scheduled for service in 1959, which is expected to minimize transference of cold at high altitudes. About one mile of cabin floor supports per plane will be made of reinforced epoxy resins instead of the conventional aluminum. Passengers flying in the new jet aircraft will never get cold feet, the company states.

The DC-8's will fly at a maximum altitude of 40,000 feet where the temperature drops down to —65°F. Aluminum floor supports would permit this intense cold to penetrate from the unheated baggage area below to the floor of the plane and create passenger discomfort. Thermal insulation will be provided by the laminated supports.

Some of the structural floor laminates are made by Swedlow Plastics Company, Los Angeles, California, in 10-foot sections. Shaped in the form of a "U", the supports are one-inch wide, one-inch deep and have ¾-inch flanges at the base. They are bonded to the main beams of the aircraft on three-inch centers, and serve as the supports for the aluminum floor. Swedlow produces the supports to Douglas specifications in matched aluminum dies. Construction begins with a layer of 181 glass cloth over the male die, the sleeving being folded double and positioned at the leg fillets to provide the strength needed at this critical structural area. Another ply of the glass cloth is positioned over the crown which serves as a doubler for additional reinforcement. The glass fiber is pre-impregnated with a formulation of Epon 828 resin and curing agent designed to produce a self-extinguishing plastic system.

Successive Lengths Shorter

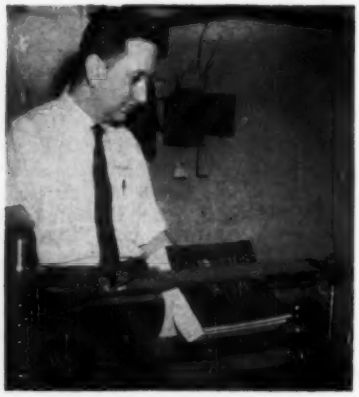
Four additional plies of glass cloth are draped over the assembly and the female mold is then positioned on top. To keep the doubled plies from slipping, they are sewed to the first layer of glass cloth. This is necessary to ensure that the fillet will be true for the entire 10-foot length of the support. The taper on the U-shaped legs is made by cutting each successive length of glass cloth slightly shorter than the previous one. Cure takes place with either an integral heating system or in an oven, both of which are applicable. Pressure is applied with either press or hydraulic clamping. The cure cycle is in two stages: three hours at 180°F, followed by a post cure of two hours at 400°F. Maximum strength of the assembly is obtainable only after post-curing of the resin.

adhesive products play a major role in UN publishing activities

Bookbinding at the UN

Adhesive products and equipment are playing a major role in the publishing services maintained by the United Nations in New York City. Applications include an unusual offset paste-up technique, pad-binding and bookbinding printed reports, and the rebinding into a handling-resistant format of books destined for wide circulation among U. N. personnel.

Each morning the Publishing Service sends out copies of the U. N. *Journal* for distribution to delegates. The *Journal*, a photo-offset resume of the past and the coming day's activities, is printed in English, French and Spanish.



Automatic fanning over rotating glue roller allows even penetration of the resin adhesive into the book's binding edge.

ADHESIVES AGE wishes to acknowledge the cooperation extended to its staff members by the Publishing Services of the United Nations in the preparation of this article.

From 6 P.M. to 3 A.M., as copy arrives from the editing and translating sections it is fed into a battery of Justowriters for preparation as margin-adjusted type copy. When all the copy is ready, a cold composition layout is made.

The U.N. at one time used rubber cement to prepare a paste-up for photo-reproduction on an offset plate. They have since switched to a double-faced pressure-sensitive adhesive paper which they find eliminates liquid adhesive smearing and is easier to manipulate and trim in the composing room.

Aside from specialized activities such as the *Journal*, the Service is, of course, occupied with a multitude of routine reproduction and binding operations. For example, a substantial number of offset or mimeographed reports must be bound into book form. A variety of binding techniques are used here, but none is more simple or intriguing than the pad-binding technique.

Though extremely simple, pad-binding never fails to amaze viewers previously unfamiliar with the method. The impressive ease of this technique has caused it to be adopted by the New York Public Library, New York University and many other organizations with similar binding problems.

As various reports come down to the binding sections, they are stacked on tables and the adhering staples removed. Once cardboard separators are inserted, the stack is ready for binding.

A strip of super or cheesecloth is laid over the edges to be bound, and the stack is aligned to offer a uniform surface. A heavy layer of adhesive is then applied.

Applying the Adhesive

At the U.N., a high-viscosity, heavily-plasticized, polyvinyl acetate emulsion type adhesive is used. Brushed into the cheesecloth, the adhesive forms a smooth, continuous film. If desired, it can be applied in a two-coat application by thinning each coat with water.

When the binding coat is dry, the stack is separated into individual reports and a hot animal-based flexible

glue is used to affix an identifying spine to each. The completely bound reports may now be returned to the distribution sections or to the filing apparatus.

By using an Eherlemann binder, a German import, a similar type of binding is produced when longer runs are being made. In this technique, two motions of the machine are used to fan the book over a rotating glue roller. The adhesive penetrates the signature edges to form a uniform coating. Text covers and body sheets are glued simultaneously; a cloth spine is attached later in a separate operation.

Special German Adhesive

The adhesive employed on this binding equipment is a specially selected resin emulsion imported from Germany specifically for the machine. It is applied to the sheet edges by a set of transparent plastic rollers.

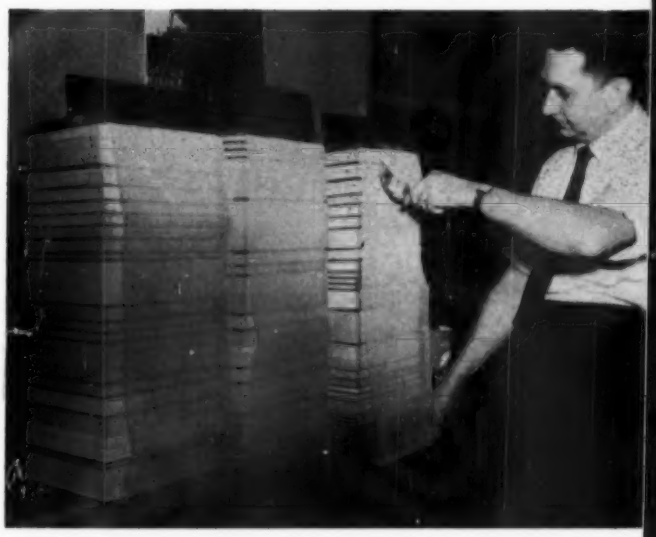
A Sheridan binding machine is used by the Publishing Service when more conventional binding applications are involved. With this unit, the adhesive used is a flexible animal glue. Permanently plasticized for full flexibility, the slightly water-diluted adhesive is run on the machine at a temperature of approximately 135°F. The resultant bond is fully flexible and resistant to the distortion and embrittlement sometimes produced by low relative humidity.

Books from all over the world are purchased by the U.N. for the popular reading section of its library. Many of these imported volumes are inadequately bound for mass circulation and the weaknesses of the bindings are generally related to the adhesive used. The greatest problem in this area is the use of an adhesive with relatively low film flexibility.

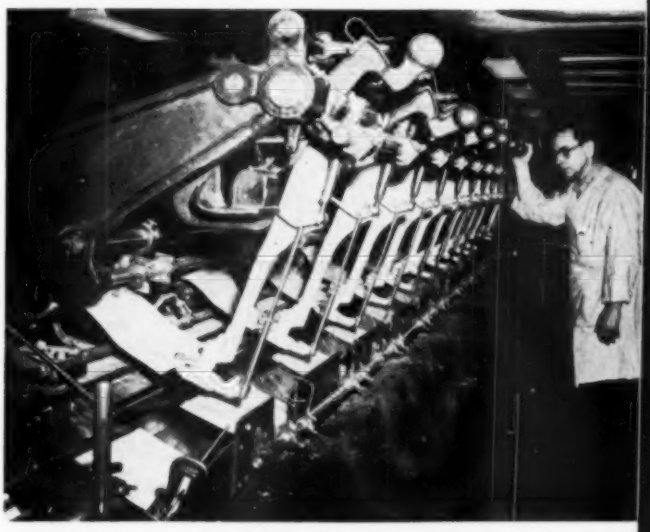
Rebinding Service

Under moderate impacts or prolonged handling, these films will generally rupture, and the binding of the book is seriously impaired. To prolong the lives of these books, the Publishing Service very often strips and rebinds the volumes before placing them in general circulation.

Since the production of the U.N. is counted in ideas, anything which aids their dissemination and preservation is important. The techniques described here are, therefore, making a valuable contribution to the furtherance of the "world's work."



Cheesecloth adhered to the backs of stacked reports is the basis of a simplified pad-binding technique.



Signatures are gathered on a collating machine prior to the stitching and gluing operations.

Before the covers are applied, the report sheets are glued off on a Sheridan machine.

NEWS OF THE ADHESIVES WORLD

A. S. M. E. Division Discusses Adhesives

Approximately 90 members attended a technical session on Adhesives, sponsored by the Rubber and Plastics Division of the American Society of Mechanical Engineers, which was held on December 3 at the Statler Hilton Hotel, New York, N.Y., during the Society's Annual Meeting. The session began at 9:30 a.m., with D. M. Alstadt (Lord Manufacturing) presiding and R. F. Westover (Bell Telephone Laboratories) acting as vice-chairman.

The first paper, entitled "Epoxy Resins and their Applications" was presented by D. Richart, S. H. Richardson and C. F. Pitt (Bakelite). The authors discussed epoxy resins and their applications with particular emphasis on adhesives, giving a brief description of the chemistry of resins, various materials available as curing agents, and properties of cured systems. Adhesion was also discussed from the standpoint of theory, types of adhesives and particular applications for epoxy adhesives.

"The Strength of Curved Glued Laminated Wood Timbers as Affected by Radius of Curvature and Lamination Thickness," was presented by William J. Finnorn (Timber Engineering) and Andrew Rapavi (Bureau of Ships). The radius of curvature stressing wood to proportional limit and to rupture were determined for various thicknesses of white oak and several other woods. White oak beams of different lamination thicknesses were laminated to a 72-inch radius of curvature and tested for bending strength.

Other papers presented at this meeting were "New Developments in Reinforcements", by W. E. Dirkes (Wright-Patterson Air Force Base); "Prediction of Load and Creep-Deflection in Beams and Eccentrically-Loaded Members", by Omar Sidebottom and Sangiah Dharmarajan (University of Illinois); "Room Temperature Vulcanizing Silicone Rubber, A Versatile New Engineering Material", by R. Treat, Jr. (General Electric); and "Control of Flexural Strength of Glass Fiber Resin Laminates by Glass Surface Treatment and Theoretical Implications", by Nicholas M. Trivisonno (Goodrich Research Center).

Prenatal Plant Care

For those who would rather work with a bucket of seeds than an acre of plants, American Metal Climax Inc., New York, N.Y., has worked out a convenient adhesive-based method for applying plant nutrient. Moly-Gro is a packaged molybdenum - adhesive - sequestering agent which applies trace elements of molybdenum to plants while they are still in seed form. Available in two-ounce, one-pound and five-pound packages, the new product will be marketed through Motomco, Inc., Clark, N.J.

General Mills Report

In its regular mid-year report to stockholders, General Mills announced a net income of $7,746,821 for the six months between June 1 and November 30, 1958. Sales for the first half of the company's current fiscal year totaled $274,291,340, an increase of more than $9,000,000 over the same period for 1957.

Net income per share of common stock rose to $3.14, as compared to $2.59 for the six-month period last year and $1.97 for the corresponding period in 1956.

1958 Chemical Sales Close To '57 Record

Momentarily slowed down by the general recession, the nation's chemical industry snapped back in the middle of the year and should close out 1958 with total sales approximating the 1957 record, according to the Manufacturing Chemists' Association.

An MCA report points out that figures available in December indicated that industry sales for the year will be between $23.3 billion and $23.7 billion. An all-time high of $23.418 billion was set in 1957.

During the third quarter of the year, profits jumped from 6.7 to 7 per cent of sales. While the production index for chemicals and allied products averaged 182 through October, the preliminary figure for October alone is 188. This surpasses the 1957 record average of 184.

As sales rose, industry inventories were reduced and by October they stood at an estimated $3.747 billion. An inventory-to-sales ratio of slightly less than two to one is generally considered desirable.

Although the cost-price squeeze continues, the preliminary wholesale price index for chemicals was 110.3 in October. The figure for October 1957, was 110.4.

Total assets of the industry were listed as $20.4 billion by the end of the year's third quarter. Profits after taxes as a per cent of assets were estimated at 7.5 per cent for 1958, compared with an 8.8 figure for 1957. Capital expenditures for the year were estimated at $1.338 billion. Employment through November was 826,000, or 23,000 less than last year's average. Approximately $543 million a year was spent on research and development and more than 400 new chemical products were introduced.

Crash Kills Three

Three employees of LePage's Inc., a division of Johnson & Johnson, New Brunswick, N.J., were killed recently in a Rhode Island plane crash which took the lives of seven. The men were on their way to a conference to be held at the LePage plant in Gloucester, Mass.

The victims are Milton A. Bergstedt, 45, technical director; Jesse Hackney Jr., 34, production supervisor; and Raymond C. Buese, 44, production supervisor. The other men, all employees of the parent firm, are Alexander Sable 38, pilot; Edward F. Luidvinaitis, 35, co-pilot; Fernand Liot, 39, plant manager, J & J Eastern Surgical Dressing Plant; and Stephen Baksa, 44, chief engineer, J & J Eastern Surgical Dressing Plant.

Mr. Bergstedt had recently been promoted to the post of technical director of LePage's. Employed by J & J for the last 13 years, he had been a group research and development leader at Permacel Tape Co., another company subsidiary. Previous to this he had been employed by the General Aniline & Film Co.

Jesse Hackney Jr. had been transferred to the Gloucester plant of LePage's seven months ago. He had previously been at a small tape manufacturing plant in Pleasantville, N.J.

Raymond C. Buese had joined J & J five years ago. He was transferred to the LePage subsidiary only a week before the fatal crash.

Kobond Carrier Stock

A cold-water-swelling carrier stock for corrugated fiber board is announced by National Starch Products, Inc. The company states that the new material can cut over-all adhesive costs by as much as 20 per cent. Designated as Kobond, it is said to have good viscosity reproducibility and resistance to mechanical breakdown. The product does not penetrate the fiber board, states National.

Colton Reduces Prices

Effective immediately, prices of Vinac RP-250 Powder, redispersible polyvinyl acetate in powdered form, are reduced by from 4 to 33 per cent, according to an announcement from Colton Chemical Co., a Division of Air Reduction Co., Inc., Cleveland, Ohio. The percentage of reduction depends upon the quantities ordered.

Leonard H. Lipman

Millard G. Brekke

Form Corrugating Adhesive Consulting Firm

The formation of a consulting company equipped to cover all phases of corrugating adhesive preparation and use is announced by Leonard H. Lipman and Millard G. Brekke. To be known as Corrugating, Adhesive, & Combiner Consultants, Inc., the new firm will offer a service tailored to meet contracting plant requirements. Headquarters of the new company will be in New Brunswick, N.J.

The company will have at its disposal newly designed equipment capable of measuring the amount of adhesive used at each single and double facer unit. Its program will also cover the operation of the combiner and the steam system. All operations will be on a management engineering level, and the company will not engage in the sale of any raw materials.

Both Mr. Lipman and Mr. Brekke were formerly with Stein, Hall & Co., Inc., New York, N.Y. Mr. Lipman was manager of the Corrugating Industry Department. Previously he had been with Olin Mathieson Co. Millard Brekke is a corrugating adhesive expert and has published several articles on various industry techniques.

High Amylose Starch

A new starch containing 55 per cent amylose will shortly be in use as a bonding agent between pulp fibers used in paper making. Named Amylomaize 1, the starch is the result of a joint research venture by American Maize Products Co. and National Starch Products, Inc.

The key to this new entry in the adhesives field is the development of a high amylose corn by Bear Hybrid Corn Co., Decatur, Ill. Two Indiana farms under contract to American Maize and National Starch were used to grow 10,000 bushels of high amylose corn from special seed raised by Bear Hybrid.

IC Appoints Spitzer

Francis A. E. Spitzer has been appointed division president of the International Division of Interchemical Corp. He succeeds Joseph G. Morris, who is relinquishing his executive position in accordance with the company's retirement policies. Mr. Morris will continue to serve the International Division on special assignments.

Associated with Interchemical for 20 years, Mr. Spitzer joined the company in 1939 as a member of its legal department. For the past two years he has served as division vice-president of the International Division.

New Armstrong Sealer

Armstrong Cork Co.'s Industrial Division has developed a new sealer which has a permanently elastic caulking consistency. It is said to maintain excellent adhesion to most materials even after extensive aging within a temperature range of 160°F. to −40°F. In addition to general industrial use for sealing out dust, dirt and water, P-606 is designed for application as an automobile windshield and back light sealer.

Solvent evaporation causes the sealer to change from a viscous fluid to a resilient plastic form. Its natural color is gray but it can be pigmented darker if required. P-606 shows no visible deterioration after 500 hours weatherometer exposure and no visible change after 140 hours of exposure to 8 ppm ozone. After aging at 158°F. for seven days, there was no hairline cracking of specimens.

The new sealer can be extruded as received and should not be thinned. Viscosity becomes thinner at elevated temperature and thickens at lower temperature. It is suitable for application by hand caulking gun or pressure pump system.

Extender Pigments

An extensive range of kaolinites (aluminum silicates) are now available from J. M. Huber Corp., New York, N.Y. The company's extender pigments are prepared by three different methods of refinement and fractionation: dry-refining, washing and calcining. Exclusive properties and particle-size ranges are available for the adhesive formulator's needs.

A new product-labeling system will speed up identification of the proper pigment. Under this system, all of the Huber pigments are numbered in reference to the percentage of particles under two microns. For example, Huber No. 35 indicates that 35 per cent of its particles are under two microns in diameter.

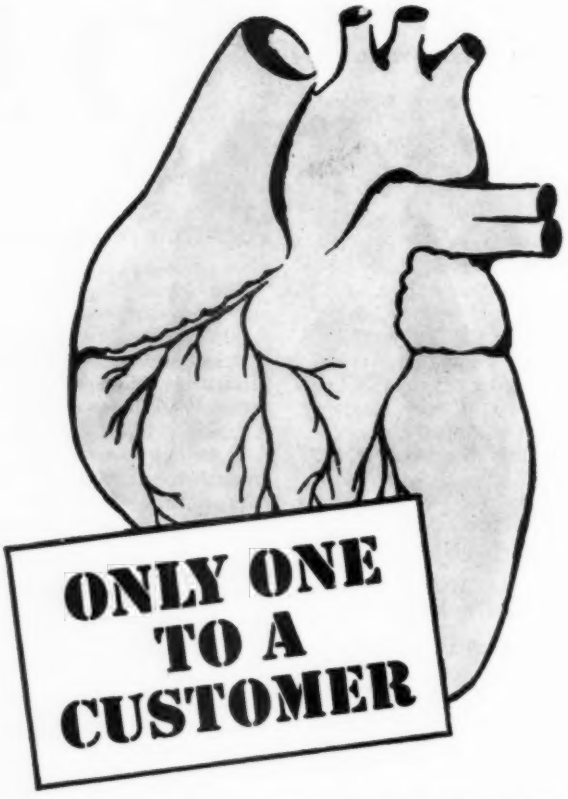
Move Sales Office

The northern sales offices of Arnold, Hoffman and Co., Inc. are now located at the company's home office building, 55 Canal St., Providence, R.I. The operation is under the supervision of Arthur C. Merrill, who will assume the post of office manager. For the convenience of customers heretofore serviced from the company's New Jersey warehouse, Ahco will maintain warehouse stocks in Paterson, N.J.

G-E Assigns Lexan Resin Project

Assignment of the Lexan polycarbonate resin project to General Electric Co.'s Chemical Material Dept. has been announced by Dr. A. E. Schubert, department general manager. At the same time, Dr. George E. McCullough was named polycarbonate manufacturing manager, and Dr. Leroy S. Moody was appointed polycarbonate engineering manager.

Dr. McCullough, who joined GE in 1948, has been manager of the manufacturing development section of the chemical development department since 1956. Dr. Moody, a graduate of Wesleyan University, joined GE in 1945, and for the last two years has been manager of the new product development laboratory of the chemical development department.



Hearts come only one to a customer. That's why it is vital for you to keep up the fight to guard yours from disease.

We are winning the fight against heart disease. Because you gave to the Heart Fund, research is saving hearts and lives.

For more progress, give generously to the Heart Fund. Give to safeguard your one heart, and the hearts of all those you love.

HELP YOUR HEART FUND HELP YOUR HEART

Design Show Planned

Approximately 400 companies are expected to be represented at the Design Engineering Show to be held in Philadelphia's Convention Hall, May 25-28. The show will coincide with the fourth annual Design Engineering Conference sponsored by the machine design division of the American Society of Mechanical Engineers.

Exhibits, which are prepared to aid in the designing of new end products, include adhesives, mechanical components, power transmission equipment, electrical and electronic components, metals, non-metallic materials, finishes and coatings, pneumatic components, and various engineering equipment and services. Of the 18,000 who attended last year's exhibit in Chicago, 73 per cent were engineers and the remaining 23 per cent were management representatives.

Advance registration cards, conference programs and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Avenue, New York 17, N.Y.

Commercial Polyox

Union Carbide Chemicals has announced the availability of three new commercial grades of Polyox water soluble resins. More than 1,000,000 pounds a year will be turned at the company's recently completed installation at South Charleston, W. Va.

The three commercial grades of Polyox are designated as WSR-35, WSR-205 and WSR-301. They will range in price from 85¢ to $1.05 a pound depending upon the quantity ordered. In the adhesives industry, these resins are blended with polyvinyl acetate, copolymers of vinyl acetate, acrylic emulsions, and polyacrylic acid. Union Carbide points out that adhesives made in this way have good leveling, flow-out, and viscosity stability.

Diepoxide For Plastics

Commercial production of Epoxide-201 is expected to start next spring, according to an announcement from Union Carbide Chemicals. Used in epoxy plastics, this new diepoxide is said to be easy to work with because of its low viscosity at room temperature. Carbide officials point out that it can be used in adhesives, electrical laminates and high temperature dies.

Portrait of

Dale G. Higgins

One of the members of the ADHESIVES AGE Editorial Advisory Board, for the last eight years, Mr. Higgins has been the general sales manager of the John Waldron Corp., New Brunswick, N.J. A subsidiary of Midland-Ross Corp., Waldron manufactures machinery for laminating, coating, impregnating, printing and embossing.

30 Years' Experience

Mr. Higgins, who received his degree in chemical engineering from Ohio State University in 1928, has almost 30 years of practical experience in adhesives and related fields. Specific aspects of industrial adhesives in which he has been involved include work on gummed paper coating equipment; pressure sensitive tape coating lines; adhesives application to webs for both abrasive papers and beaded movie screens; and the lamination of all types of foils, films, cloth, papers, boards, etc.

Worked In Coated Fabrics

For 14 years, he was research supervisor of Du Pont's Fabrikoid Division and worked on the development of new coated products. After that he served for five years as plant manager of the Pantasote Co., makers of coated fabrics and calendered films. For two years before joining Waldron, he was a consultant on the purchase, installation and operation in England, Brazil and Belgium of complete plants for coated fabrics and calendered films.

Glass Attachment

A bonded Fiberglas-reinforced phenolic edge attachment developed for the Air Force permits glass in both flat and complex shapes to be used as a structural element to the full limits of its working stresses. The attachment can be drilled or machined, and it allows mechanical mounting of the glass other than the usual clamping and puttying methods. It can also be adapted for mounting laminated glass.

According to a report in the U.S. Department of Commerce's *Technical Reports Newsletter*, tests showed that glass with the bonded edge attachment can be used as a structural element capable of carrying tensile loads over the temperature range of −75° to 500°F. without the inducement of detrimental localized stresses. Use of the attachment on full-scale parts of complex shapes and contours has resulted in values for maximum working tensile stresses higher than those published for glass.

Permacel Cellophane Tape

Permacel, New Brunswick, N.J., is now marketing a new pressure-sensitive, clear, cellophane tape. Designated as Permacel 44, the tape is extremely thin, has a high tensile strength and excellent edge tear resistance. A rubber-base adhesive has been especially formulated to give the product excellent adhesion to a variety of surfaces and good unwind characteristics.

Resistant to grease, oil and solvents, the new tape is said to be particularly suited for sealing boxes, bags, envelopes, and both paper or metal canisters. Since it can be dispensed by hand, semi-automatic or fully automatic packaging machinery, Permacel 44 can be used in high-speed packaging operations.

New Engineering Service

A new design engineering service, to be known as AA Industries, is announced by AA Gage Co., Detroit, Mich. Officials of the company point out that an outstanding advantage of their service will be the practical shop experience of their engineers. This is expected to result in designs that are both practical and less expensive to build. AA Industries will offer three options to its service: design only, design and build, or build only. The setup will provide a complete single source for any phase of a tooling program.

names in the news

John T. Castles has been named manager of General Electric Co.'s Chemical Development Operation, and he will be responsible for conducting product and process development on new materials.

Judson S. Bryant was named controller of international operations for the Borden Chemical Co. He will be in charge of coordination and control of accounting, tax and financial matters of the division's foreign subsidiaries.

Harry A. Bullis has resigned as chairman of the board of directors of General Mills, Inc. President Eisenhower recently appointed him chairman of the International Development Advisory Board.

James F. King has been appointed presidential assistant in charge of government relations for the Manufacturing Chemists' Association, Inc. Mr. King has held a number of government advisory positions. He came to MCA after serving as assistant to the director of the Office of Civil and Defense Mobilization.

Ronald A. Reynolds, previously Ontario sales representative of The Borden Chemical Co. (Canada), has been appointed the company's Ontario sales manager.

James A. Hughes assumes the duties of secretary of the Diamond Alkali Co. His new assignment is in addition to his post as Diamond's vice-president in charge of administration.

Harry N. Lowell joins the Organic Chemicals Sales Dept., Dewey and Almy Chemical Division, W. R. Grace & Co. He was formerly a member of the company's Marketing Research Department.

Sheldon F. Jones, C. Leo Masuret, Thomas K. O'Brien, Jr., Doan T. Pickering, Jr., and **Kenneth W. Thomas** have been appointed to the sales staff of Formica Corp.

Roger E. Hatch, who has been assistant sales manager of Polymer Corp. Ltd. since 1954, has been appointed general sales manager of the company. He has been with Polymer for approximately 12 years.

William A. Angus

Angus Joins R&A

William A. Angus has joined Rubber & Asbestos Corp., Bloomfield, N.J., manufacturers of industrial adhesives, as vice-president in charge of sales. The newly established executive position in the company's marketing structure was necessitated by the rapid expansion of R&A's national field sales staff.

Associated with the adhesives and plastics industries for over 12 years, Mr. Angus was formerly the eastern regional sales manager for Minnesota Mining & Manufacturing Co. Previous to joining R&A, he headed his own organization representing manufacturers in the fields of compounded products and electronic components. He is a member of the Curtain Wall Sealant Committee and of the Technical Committee of the Adhesives Council, as well as of the Building Research Institute.

Narmco Overseas Offices

The opening of overseas technical sales offices in Japan and Australia was recently announced by Narmco Resins & Coatings Co., producers of structural adhesives for military, industrial and consumer use. According to Clifford W. Brown, president of Narmco, the company's accelerated international sales development program reflects the growing demand abroad for structural aircraft and missile materials of United States quality. The firm now has technical sales representatives in seven European cities in addition to those in Japan and Australia.

Narmco's technical representative in Tokyo is Tokyo Sales, Inc.; its representative in Australia is J. A. Latham Pty. Ltd.

ACS Names Elder

Albert Lawrence Elder, director of research at Corn Products Co., has been chosen president-elect of the American Chemical Society for 1959. A member of the Chicago Section of ACS, Elder joined the organization in 1925. He is also a member of AAS, AIC, Institute of Food Technology, and the Quartermaster Food & Container Institute.

Building New Plant

To produce industrial adhesives used in the paper industry, the Pacific Glue Mfg. Co., Seattle, Wash., will build a second plant at Vancouver, Wash. According to company officials, the new plant will serve the Portland-Vancouver area.

ADM Expands Line

Commercial quantity production of amides, industrially useful fatty nitrogen chemicals, is announced by the Archer-Daniels-Midland Co., Minneapolis, Minn. Available through the company's development department, the amides are the newest members of ADM's expanding line of fatty nitrogen compounds. These products are marketed under the trade name of Adogen.

Amides are used for improving the adhesion of printing inks, as foam stabilizers in detergents, and to improve the penetration, flexibility and translucency of wet-waxed paper coatings. They have application in the manufacture of plastics, pressure sensitive tapes, molded rubber products and as wire drawing lubricants.

High Temperature Study

Research to reveal the mechanisms of observed deterioration of organic-base adhesives employed in metal-to-metal bonds in service at elevated temperatures is reported by the Air Force. The investigations are detailed in "A Study of the Deterioration of Adhesives in Metal Bonds at High Temperatures," by J. M. Black and R. F. Blomquist. The 45-page report is published by the U.S. Department of Agriculture for Wright Air Development Center and is priced at $1.25.

Investigations reported deal with the performance characteristics of laboratory-formulated phenol-fomaldehyde-epoxy resin adhesives previously shown to be among the more heat-resistant types of adhesives for bonding metal. The thermal resistance of adhesive bonds in aluminum and stainless steel as affected by preparation of the metal surface, curing conditions, aging temperature, aging time, atmosphere during aging, and stress were studied.

It was found that the aging of aluminum bonds at 300° and 400°F. under stress increased the strength of bonds later tested at −70° and 80°F. by as much as 30 per cent. Cycling of bonded aluminum and stainless steel between temperatures of 450° and −55°F. produced no evidence of failure caused by thermal shock or differences in expansion between adhesive and adherend. Chemical changes of a phenol-epoxy resin aged at 550°F. in air and nitrogen were studied by infrared spectrophotometry. Qualitative interpretation of the results showed a significant increase in absorption in the carbonyl region of the spectra during aging.

Paper Week Symposium

A jointly sponsored research symposium will be presented by the Technical Association of the Pulp and Paper Industry and the American Paper and Pulp Association on February 26, at the Waldorf Astoria Hotel in New York City. Held in conjunction with Paper Week, the program is designed to alert the paper industry to the need for more intensive and intelligently administrated research.

Featured speakers at the symposium will be Lt. Gen. James M. Gavin, vice-president of Arthur D. Little, Inc.; A. B. Layton, president of Crown Zellerbach Corp.; and Howard S. Turner, vice-president of Jones & Laughlin Steel Corp.

Mort P. Schester

Polytex Adhesives Formed

Mort P. Schester has announced the formation of the Polytex Adhesives Corp., manufacturers of solvent cements and latex based adhesives, with a newly equipped plant located at 41 Midland Ave., Wallington, N.J. The new plant has modern equipment for heavy duty rubber and plastic milling as well as solvent solutioning. It features the latest safety devices for handling volatile solvents. Special heavy duty dispersing and compounding equipment will be used to manufacture aqueous adhesives up to the heaviest paste consistencies with a high degree of smoothness and uniformity.

The new operation will produce high strength general and special purpose solvent adhesives for automotive, structural and specialized uses. New pressure sensitive and reactivating cements are to be offered to the tape, sponge rubber and felt industries. Special products also will be available to the building industry. Staffed with thoroughly experienced and trained personnel, Polytex Adhesives will offer complete technical and manufacturing services to all industries within the scope of its operations.

Receives TAPPI Medal

Karl O. Elkerkin, president of Bowaters Research and Development, Inc., Calhoun, Tenn., has been named the 27th TAPPI Medalist of the Technical Association of the Pulp and Paper Industry. The award is made on the basis of outstanding contributions toward the technical advancement of the pulp and paper industry. Presentation of the medal will be the principal feature of the organization's annual luncheon, to be held on February 26 at the Commodore Hotel, New York, N.Y.

Hodag Extends Services

Hodag Chemical Corp., Chicago, Ill., has formed a Technical Services Department, which will be supervised by Y. Snider, research chemist. Mr. Snider, who has been with Hodag for three years, was previously associated with the Army Chemical Corps Research Center in Maryland. He holds B.S. and M.S. degrees in chemistry from the University of Chicago.

The new department, which represents a major expansion of the company's laboratory resources, will analyze customers' processing problems related to foaming and other forms of surface activity. Application studies will be made in Hodag's laboratory which simulate customers' manufacturing processes. When the processes can not be duplicated, a member of the Technical Services Department will join a Hodag sales engineer and will work with customers' engineering personnel in the field. Company products will be tested in connection with customers' materials and systems to determine their suitability to the problem at hand. New testing equipment has been added for this purpose.

New Diamond Line-up

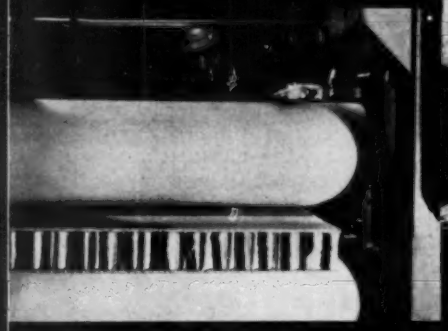
Harry E. Connors has been named product manager of paste resins for Diamond Alkali, Cleveland, Ohio. Mr. Connor was formerly with Interchemical Corp. Other new Diamond appointments include Charles E. Henry, Phillip I. Johnson, Alexander A. Jigger and James N. Jenkins who will all handle sales of PVC resins. At the same time, Herbert C. Jardine was named sales representative in the southeastern states for the plastics division, Raymond A. Chartier given the assignment of technical service representative on calendering resins, and Peter S. Weill, on paste resins.

Two DuPont Prices Cut

Elastomer Chemicals Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has announced price reductions on two special isocyanate products. Hylene M organic isocyanate has been cut by 50¢ per pound from $1.75 to $1.25, while Hylene M-50, a solution used in adhesives manufacture, has been reduced from $1.00 per pound to 86¢. Both prices apply to 55 gallon drums in less than carload lots.

ADHESIVES ⇨ ⇨ NEW MARKET

WOOD PRODUCTS: Synthetic resin adhesives bond wood chips—reclaimed from wood scraps and wastes—into particle boards used in a wide variety of products. The mat, shown coming out of the pre-compression platens where it was reduced from a thickness of 6 to 4 inches, will eventually become a ¾ inch board. (Reichhold Chemicals)



SANDWICH PANELS: A high-strength, flexible adhesive eliminates need for heated presses—saves production time and money—in fabrication of lightweight sandwich panels for non-load bearing uses. Maximum strength bond is accomplished swiftly on nip roller or cold press, and without employment of clamps. (Minnesota Mining and Manufacturing Company)

HEAVY DUTY PACKAGING: Adhesives play a role in the manufacture of waterproof papers. These products, used to shroud lumber and other industrial products for shipment, must be extremely resistant to moisture. Adhesives, natural and synthetic, in addition to acting as a laminating agent, give this waterproof quality. (American Sisalkraft Corporation)

What are your plans for '59 ?

If you make or sell industrial adhesives or adhesive products —or the materials, machinery, equipment, services and supplies that are necessary to both the production and use of adhesives—your plans should include ADHESIVES AGE.

Here is a magazine in which you can reach your whole multi-million dollar adhesives market—as a single great market. More efficiently, more effectively, more economically than ever before possible.

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10,000 circulation guaranteed throughout 1959

ADHESIVES AGE is distributed to a selected list of more than 7,000 men in user-companies and 3,000 men in manufacturing and supplier companies. While paid circulation is replacing the original distribution, circulation will be maintained at 10,000 copies during the first year.

As of November 1958, paid circulation accounted for 15% of the total—1,500 copies, all at full subscription price. Here are some of the titles of these subscribers: Presidents, Owners, Partners, General Managers, Plant Superintendents, Technical Directors, Research and Product Development Directors, Materials Engineers, Process Engineers and Purchasing Agents.

Ask for a copy of the report: ADHESIVES AGE—Market and Magazine . . . including material from basic Mills Shepard research.

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ADHESIVES AGE NEW MAGAZINE

ASEE Opens Nominations

The American Society for Engineering Education, Urbana, Ill., has opened nominations for the four principal awards in engineering education to be presented by the society during its 1959 annual meeting in Pittsburgh, Penna., June 15-19. The awards are: the Lamme Award, a gold medal given annually since 1928 to honor "distinguished achievements which contribute to the advancement of engineering education;" the George Westinghouse $1000 Award "to recognize and encourage outstanding contributions to the teaching of students of engineering;" the Vincent Bendix Award for "advancement of engineering research program in college and universities" and the $1000 Curtis W. McGraw Research Award to recognize and encourage "early achievements by engineering college research workers under 40 years of age."

$300 in Prizes

In addition, the society will award $300 in prizes for the best papers written by ASEE members under 36 years of age and appropriately entered in the national contest. ASEE's Technical Institute Division also will present the James H. McGraw Award of $500 to a leader in technical institute education.

Information regarding these awards and appropriate nomination forms may be obtained from Prof. W. Leighton Collins, ASEE secretary, at the University of Illinois, Urbana, Ill. and from appropriate society committees.

Atlas Appointments

Atlas Powder Co. has announced several changes in the line-up of its Chemical Sales Department. Henry C. S. Swab has been named general sales manager of the Aquaness Department located in Houston. He will be succeeded as manager of Atlas' New York sales office by William A. Kessel. Other appointments include William R. Lucas, assistant regional manager of the New York region; William P. Hillman, Jr., assistant regional manager of the Wilmington region; and Joseph J. Byrne, assistant to the field sales manager.

PVA Price Reduced

E. I. du Pont de Nemours, Inc., Wilmington, Del., has announced an 11 per cent price reduction for its polyvinyl acetate emulsion. The price reduction amounts to 2¢ per pound, putting homopolymers at 16¢ and copolymers at 18¢. Other PVA producers also reduced their prices, a majority putting homopolymers at 16¢, but holding the copolymers drop to 18½¢, ½¢ above DuPont's new price. PVA prices are now at their lowest, more than one-third below levels at the end of World War II.

According to DuPont, vinyl based paints now account for one quarter of water based coatings, and are continuing to expand. Adhesives and textiles are among the prime outlets. The company believes that the price reduction will stimulate PVA usage in grease-resistant coatings for paper and paperboard.

Borden Appoints Two

The Consumer Products Department, Borden Chemical Co., New York, N.Y., has announced the appointment of two new sales representatives, Frederick C. Kappen and Joseph J. Granbeck, Jr. Mr. Kappen, who will be headquartered in Los Angeles, will serve southern California, Arizona and New Mexico. Mr. Granbeck will be located in Minneapolis and will cover Minnesota and other states in the north central area. Both representatives will be responsible for wholesaler and dealer sales of Borden's full line of "Elmer's" adhesives for the home handyman. Mr. Granbeck previously was a sales representative for Sargent & Co., and Mr. Kappen has worked for the U. S. Borax & Chemical Corp.

National Enlarging Plant

National Starch Products Inc., has announced its plans for a 50 per cent expansion of its vinyl acetate polymerization plant in Meredosia, Ill. The Meredosia plant manufactures vinyl emulsions for use in adhesives, paints, paper and textile finishing resins, and packaging materials. According to the company, this expansion marks the second time since 1955, when the plant was built, that its capacity has been increased to keep pace with the many new and diverse applications being discovered for vinyl copolymers. The new facilities are scheduled to be in operation by March, 1959.

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Jan. 31-Feb. 4. Hobby Industry Association Trade Show and Convention, Hotel Sherman, Chicago, Ill.

Feb. 2-5. National Auto Accessories Exposition, New York City Coliseum, New York, N. Y.

Feb. 3-5. 14th Reinforced Plastics Conference, Edgewater Beach Hotel, Chicago, Ill.

Feb. 18-21. International Automotive Service Industries, Navy Pier, Chicago, Ill.

Feb. 23-26. 44th TAPPI Annual Meeting, Commodore Hotel, New York, N. Y.

Mar. 9-14. American Toy Fair, New Yorker and Sheraton-McAlpin Hotels, New York, N. Y.

Mar. 17-19. 15th Annual Conference and Corrosion Show, National Association of Corrosion Engineers, Sherman Hotel, Chicago, Ill.

April 5-10. American Chemical Society, Biltmore Hotel, Boston, Mass.

April 6-8. 8th Annual Meeting of the Building Research Institute, Penn-Sheraton Hotel, Pittsburgh, Penna.

April 29-30. Manufacturing Chemists' Association, Engineering and Scientific Center, Cleveland, Ohio.

May 17-21. 61st Annual Meeting of the American Ceramic Society, Palmer House, Chicago, Ill.

May 25-28. Design Engineering Show, Convention Hall, Philadelphia, Penna.

May 25-27. 10th TAPPI Coating Conference, Statler Hotel, Boston, Mass.

May 25-27. 42nd Annual Conference of The Chemical Institute of Canada, Halifax, Nova Scotia.

June 9-12. Materials Handling Institute Exposition, Public Auditorium, Cleveland, Ohio.

June 15-19. Annual Meeting of the American Society for Engineering Education, Pittsburgh, Penna.

June 21-26. American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

July 1-19. Chicago International Fair Exposition, Navy Pier, Chicago.

Aug. 18-21. 10th TAPPI Testing Conference, Multnomah Hotel, Portland, Ore.

PVC Production Increased

Borden Chemical Co. has dedicated a new $4,000,000 addition to its polyvinyl chloride plant in Leominster, Mass. Started in November, 1957, the new facilities are expected to increase the plant's production capacity from 12 million to 38 million pounds per year.

In addition to increasing the plant's manufacturing facilities, Borden has also enlarged its development laboratories. This expansion, completed at a cost of approximately a half-million dollars, not only doubled the size of the former laboratory but also called for a 100 per cent increase in technical personnel.

Borden's also manufactures polyvinyl acetate and polyvinyl alcohol at its Leominster location. Currently under construction is a $1,500,000 polyvinyl alcohol plant which is scheduled to be completed by October, 1959. It was designed to produce five million pounds of polyvinyl alcohol annually, for use primarily by the textile and paper industries.

To Double Facilities

A $360,000 expansion program has been announced by Polymer Industries, a subsidiary of Phillip Morris Inc. Plans call for doubling the present manufacturing, laboratory and office facilities of the company's Springdale, Conn., plant. Over 12,000 square feet will be added to the manufacturing area.

B. W. Graham

Realign Sales Setup

Chemical Division of Armour and Co. has realigned its sales organization into two distinct groups to handle fatty acids and aliphatic organic compounds. According to B. W. Graham, sales director, the move was prompted by the need for highly specialized chemical sales representatives who could meet their customers' need for fast technical data and product application information services. Under the new setup, sales representatives will devote their full time to a single line of products.

Paul L. Sheppard, recently appointed sales manager, will be responsible for fatty acid-industrial oil sales exclusivey. L. M. Miller will manage the sale of aliphatic organic compounds. He will be assisted by three regional managers and their sales staffs, plus a group of industry specialists.

Heat Reactive Resin

Schenectady Varnish, Schenectady, N.Y., has announced a new heat reactive phenolic resin for making nitrile rubber adhesives. An adhesive made by combining SP-12 with nitrile rubber is said to have high tensile strength, excellent green tack, and a high thermal softening point.

3M Names Two

Carl E. Barnes was named vice-president for research at Minnesota Mining & Mfg. Co., St. Paul, Minn. At the same time, the company announced that his previous assignment as director of central research will be taken over by John W. Copenhaver.

Epoxy Plasticizers

The introduction of three epoxy plasticizers marks Emery Industries' entry into the epoxy-type plasticizer field. Two of these new products, Plastolein 9213 Epoxy and Plastolein 9214 Epoxy are epoxidized fatty acid esters that contribute to low temperature flexibility in addition to heat and light stability. The third plasticizer, Plastolein 9232 Epoxy is a polymeric type featuring extremely low extraction and volatility in addition to a high degree of heat and light stability.

All three are recommended as stabilizers in all vinyl formulations. The low-temperature types can be used in somewhat larger amounts, though their limited compatibility restricts their use to that of a secondary plasticizer.

Further information is contained in Technical Bulletin No. 413, available upon request from Dept. 5, Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio.

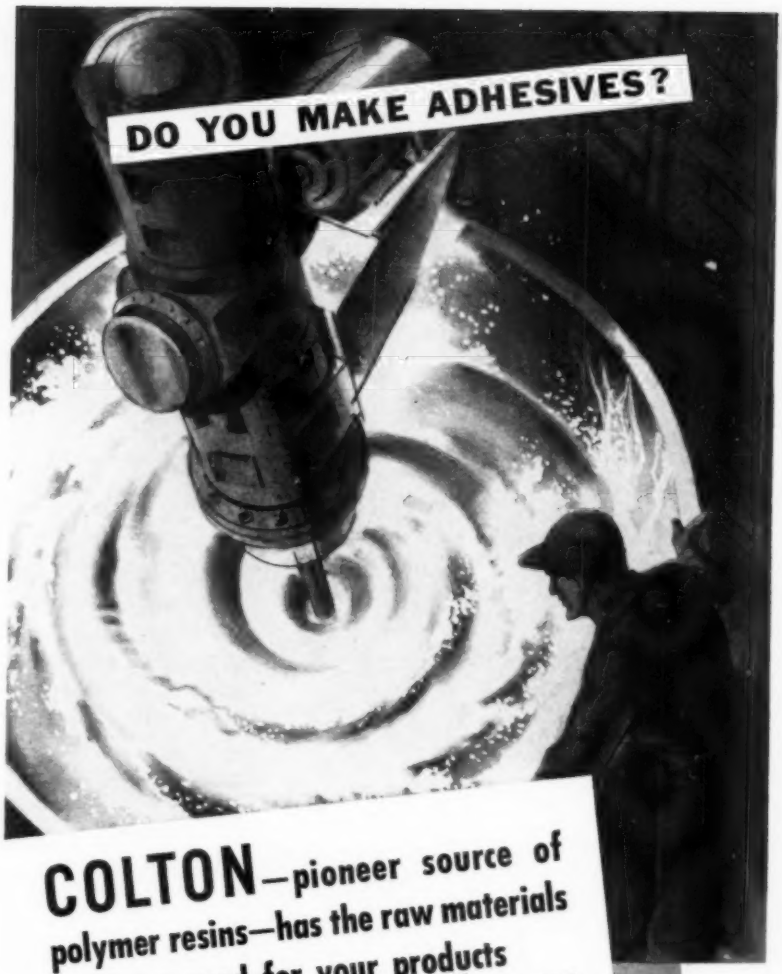
Reichhold PVA Plant

Facilities for the manufacture of polyvinyl acetate emulsions used in adhesives have been completed at the Kansas City, Kas., plant of Reichhold Chemicals, Inc. One of the largest of its kind in that area of the country, the plant is equipped to produce 15,000,000 pounds of polyvinyl acetate emulsions in a year.

By spring of this year, the productive facilities of the plant will be further increased with the completion of a new $500,000 formaldehyde producing plant now under construction. In addition to these new operations, the plant will continue manufacturing a wide range of synthetic resins.

Elected To NSC Post

Harold Horowitz, technical secretary of the Building Research Institute, has been elected chairman of the National Safety Council's Home Construction and Equipment Section. Members of the section represent organizations such as the National Board of Fire Underwriters, the AIA, the NAHB, and other groups interested in housing and building codes. The section's project for 1959 will be to provide supporting information to organizations interested in code uniformity and progress, by developing a statement of principles on what constitutes safe building design for housing.



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POLYVINYL ACETATE BEADS (Resin in Solid Form)	For formulating immediate-tack adhesives, hot melts, heat seals. Alkali-soluble grade available.
COPOLYMER VINYL ACETATE-VINYL STEARATE BEADS	*New development products.* As bases or modifiers for paper adhesives and coatings; leather finishes and adhesives. Non-toxic, grease-resistant.
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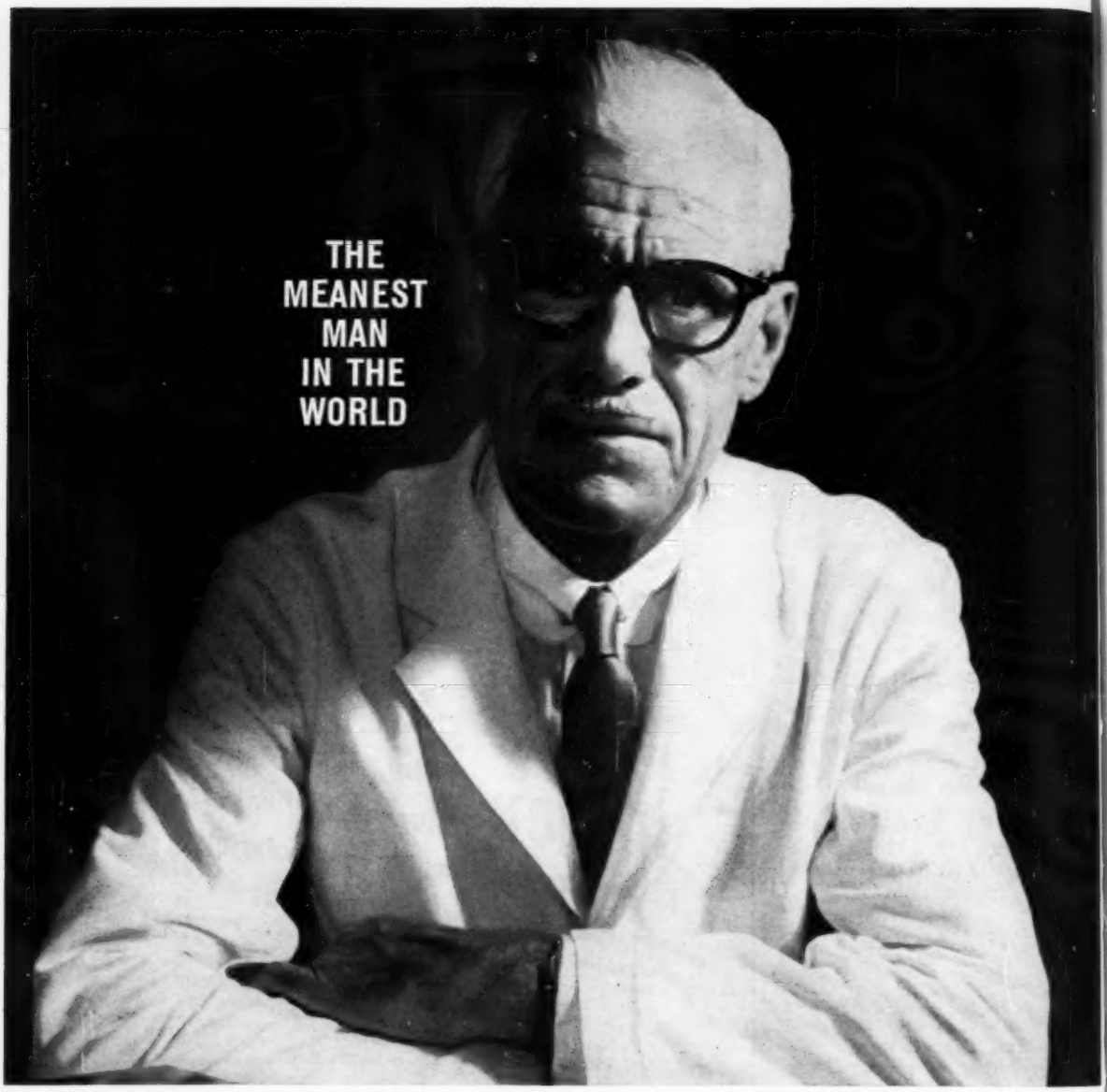

The meanest man in the world is a phony doctor—a "quack." He is utterly ruthless. He is interested only in making money, regardless of the human tragedies he causes.

One of the most vicious of all is the cancer quack. It's not easy to recognize him. He looks and acts like a doctor.

But be suspicious . . . if he offers a "secret" cure . . . if he refuses to consult with medical specialists . . . if the patients he claims he "cured" have only *his* word that they had cancer in the first place. If you have any doubts about him, check with your local county medical society.

Be cautious. Each year, Americans pay an estimated $10,000,000 to cancer quacks. And the greatest tragedy is that many cancer patients who could have been saved by prompt and skilled treatment have lost their lives to quacks.

Be wise. See your own doctor regularly. He is the only one who can give you the genuine assurance that you have no cancer. He is the only one who can help if you do have it. Remember that many cancers are curable if detected early and treated by a reputable physician. Give your doctor the chance to give *you* the chance of a lifetime.

AMERICAN CANCER SOCIETY

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MAIL TO: Your local American Cancer Society office

H. F. Rowbotham

Joins B.B. Chemical

Harrison F. Rowbotham has joined the B.B. Chemical Co., Cambridge, Mass., a subsidiary of the United Shoe Machinery Corp., as manager of their Bostik Dept. He will be responsible for marketing their expanding line of Bostik industrial adhesives. Mr. Rowbotham was formerly vice-president in charge of sales of Angier Products, Inc.

Polytex Rubber Cements

A new series of fast drying, solvent-based synthetic rubber cements is announced by Polytex Adhesives Corp., Wallington, N.J. Polytex No. 701 and No. 702 can be used to produce high strength bonds between steel, ceramics, wood, cork, leather, polyurethane and polyester foams, rigid vinyls, fabrics, aluminum, linoleum and similar compositions.

Both compositions show excellent shelf stability and the bonds they form resist moderately high temperatures well. A particularly attractive feature of the new Polytex series is its ability to bond two non-porous materials. In this type of operation, both surfaces are coated. After drying, the latent tack of the adhesive makes possible the bonding of solvent free faces.

Names New Agent

Adhesive Division, Armour & Co., Chicago, Ill., has announced the appointment of Allied Paper Products, Inc., Chattanooga, Tenn., as its southern sales representative. Allied will handle animal glues, industrial adhesives and industrial blood products.

MCA Symposium Planned

A symposium on the packaging and transportation of chemical products will be held at the Engineering and Scientific Center, Cleveland, Ohio, April 29-30, under the sponsorship of the Manufacturing Chemists' Association. The program now being drawn up by MCA's Chemical Packaging Committee will deal particularly with new developments in packaging and transporting dangerous products. Speakers will include Commissioner Howard G. Freas, chairman of the Interstate Commerce Commission; Admiral A. C. Richmond, commandant of the U.S. Coast Guard; and others prominent in regulatory groups or in the industry. Although the symposium is sponsored by a chemical industry group, registration will be open to all interested parties.

Furane Expands Line

Furane Plastics Inc. announces a new addition to its line of low density casting and trowelling compounds. Paste-like and barely flowable, Masterlite 163 fills a mold and cures at room temperature. Heat will set the material quite readily and rapidly. Large complicated shapes, many feet in length, are reproduced with considerable accuracy, Furane points out.

As a new experimental material, Masterlite 163 is envisioned as a structural reinforcing compound serving as a back-up for high strength steel or aluminum skins.

Kennedy Elected

Gerald S. Kennedy has been elected chairman of the board of directors of General Mills, Inc. He fills a post left vacant by the retirement of Harry A. Bullis, who has served as chairman for the past ten years. A member of the board since 1948, Kennedy was named executive vice-president of the company last September. He has been a company vice-president since 1943.

Forms Canadian Firm

H. B. Fuller Co., Linden, N.J. has announced that its Canadian subsidiary, H. B. Fuller Co., Ltd., Winnipeg, is planning to begin production of dextrine, starch, animal and resin adhesives at its new adhesive plant. The plant, located at 1400 Sargent Ave., Winnipeg, will have laboratories to solve specific adhesive problems.

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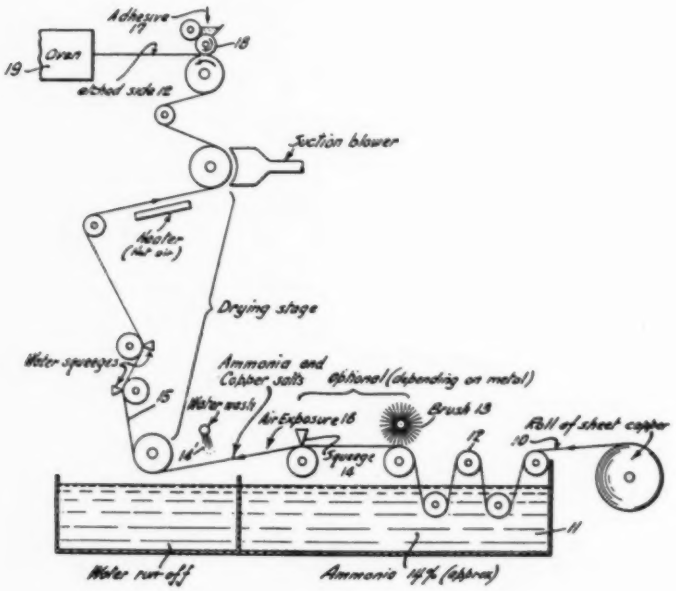
patent review

By MELVIN NORD

Adhesive-Coated Sheet

U. S. Patent 2,852,421, issued September 16, 1958 to Milton A. Bergstedt, assigned to Johnson & Johnson, provides a method of producing an adhesive-coated sheet of copper, which is particularly useful in so-called printed circuits. In these uses it is necessary that the metal be bonded to underlying surfaces in such a manner that maximum conductivity of the metal is well preserved and that the metal is insulated from the underlying surface.



As shown in the diagram, a thin sheet (10) of copper foil is used. At least one side of the metal is basic bonded by etching by submersion in a base in a bath (11), preferably ammonium hydroxide solution. The etched side (12) is cleaned with a rotary brush (13), as the copper leaves the treatment. Excess ammonia may be removed by using a rubber squeegee (14).

Following treatment, the surface is cleaned further by submersion in running water (14[1]). Removal of any excess water (15) is next. Heat treatment may serve to remove the last traces of aqueous liquid.

It is particularly helpful to expose the metal surface to air and oxidize it in presence of the base prior to removal of the base (16). After cleaning, oxidizing, washing and drying, the foil is coated on a coater (18) to provide a basic bond with adhesive film (17), preferably an adhesive film based on an aldehyde resin and an acetal.

Paper Coating Composition

U.S. Patent 2,849,326, issued August 26, 1958 to John J. Schoenberger and Gabriel T. Turula, assigned to Corn Products Refining Co., describes a method of preparation of pigment coating containing high solids content for paper and paperboard by both the machine and off-machine coating processes.

The problem which the present invention solves is the provision of an adhesive which requires no cooking, permits the use of solids content considerably above that now possible, and at the same time provides the necessary properties for adherence of the pigment to itself and to the paper fibers of the base paper.

The adhesives provided for this purpose are polymers derived from starch. They have a dextrose equivalent value of 5 to 10 and are soluble in cold water to the extent of at least 90%. The preferred adhesive is a partially hydrolyzed starch which has been dried over heated rolls or spray dried.

Dextran Bone-Glue Adhesives

U. S. Patent 2,850,398, issued September 2, 1958 to Everett E. Witt and Frederick W. Holt, Jr., assigned to Commonwealth Engineering Co. of Ohio, relates to bone-glue based compositions having improved properties.

It has been found that certain specific dextrans have the capacity, when incorporated into adhesive compositions whose primary binder is bone-glue, to enhance the properties of resistance to bacterial and enzymic attack, and the "grab" of the composition, and to improve its water-resistance.

Water-Soluble Adhesive

U.S. Patent 2,846,431, issued August 5, 1958 to Worth C. Goss, assigned to Permanante Cement Co., describes a method of producing a resinous plastic material from a sulphite pulp liquor, which can be dissolved in water of alkaline pH, and when dissolved is suitable for impregnating paper, cardboard, "softboard," and cloth materials, to give strength and water resistance.

Prior to setting, the substance becomes freely fluid under the influence of heat, pressure, and moisture, and is highly adhesive. In producing it calcium base waste sulphite liquor is stripped of excess sulphur dioxide with steam. Ammonia is then added, and the liquor is heated to 300°F. with air bubbling through it to oxidize the liquor. The ammonia is distilled from the oxidized liquor, reducing the pH to 8.0. The liquor is then filtered, centrifuged and acidified with HCl. The filtered precipitate is washed with water, neutralized with ammonia, dried and powdered.

Mobile, Hydrophobic Starch

U. S. Patent 2,852,404, issued September 16, 1958 to Robert W. Satterthwaite, assigned to Corn Products Refining Co., describes a process for preparing a highly mobile and hydrophobic starch, for use in offset printing or for dusting in foundry practice. The process consists of the following steps:

(1) Heating with agitation an aqueous slurry of starch containing 0.005 to 0.04 part of water soluble soap per part of dry starch at 100 to 140°F.;

(2) Adding 0.01 to 0.06 part of a water-soluble aluminum salt per part of dry starch;

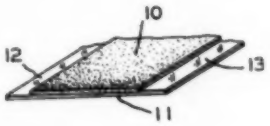
(3) Continuing the heating until aluminum soap is precipitated on the starch;

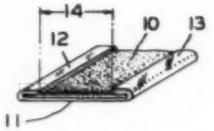
(4) Adjusting the pH of the slurry to 5 ±0.2; and

(5) Recovering the starch.

Shielding Adhesive Tape

U. S. Patent 2,852,423, issued September 16, 1958 to Rex E. Bassett, Jr., assigned to Bassett Research Corp., provides a shielding tape for lead-in wires and conductors, which is of increased mechanical strength and which is provided with an adhesive surface to assure its maintenance in proper position about the structure to be shielded.





As shown in the two schematics, the pressure sensitive tape (10) coated on both sides with an adhesive substance forms the base. Metal foil strip (11) is applied to one surface of the tape, and is bent over at 12 and 13 into close adhesive contact with the other surface of the tape. The provision of the peripheral metal strips (12-13) enables the evolution of a perfect electrical and mechanical contact with the metal surfaces of the compound tape during the application to the surface to be shielded.

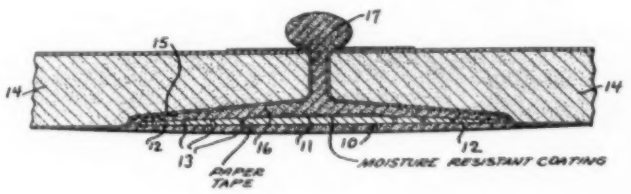
Joint Tape

U. S. Patent 2,850,404, issued September 2, 1958 to Arthur H. Dunlap, describes a paper tape for use with joint cement to conceal the joints between adjoining panels in drywall construction, and particularly those joints which have no backing. The tape prevents the joint cement from oozing out the back side of the joint and forming a surplus bead. Such a surplus bead, as it dries, causes the center portion of the tape which overlies the joint proper to be subjected to an excess of moisture as compared to the side portions of the tape. Accordingly, the latter dry much faster, and the center portion of the tape frequently stretches outward due to the excess moisture, thereby forming a paper bead defect. This defect makes a smooth finishing of the joint more difficult and frequently necessitates an extra dress coat of cement.

As shown in the diagram, paper tape (10) has a central band (11) of its back face coated with a film of a moisture-resistant material such, for example, as a rubber-base cement. For normal installations the tape is about 2-inches wide and 0.012-inch thick and the coated band (11) may be approximately ¾-inch wide.

The wing portions (12-12) at both sides of band 11 are formed with perforations (13). The function of the perforations is to hasten absorption of moisture by the tape as it is applied.

In the diagram a typical installation is illustrated for the joint between adjoining wallboard panels



(14) which have their front faces conventionally tapered at 15 to form a V-shaped joint channel for receiving the tape and joint cement (16). The joint has no backing, and so when the cement is first applied by spreading it in the joint channel it tends to erupt at the back of the joint and form an excess cement bead (17). The tape (10) is then centered over the joint and imbedded in the cement, and during this operation the perforations (13) help any trapped air to escape as well as to speed absorption of water by the tape from the cement. After the tape has then been covered by a thin layer of cement the latter is left to dry. As the joint cement dries, the moisture in the cement bead (17) is prevented from migrating directly into the center portion of the tape by the coated band (11) in the back face. Hence, the center portion will not receive an excess of moisture which might cause the objectionable paper beading condition.

Other Patents of Interest

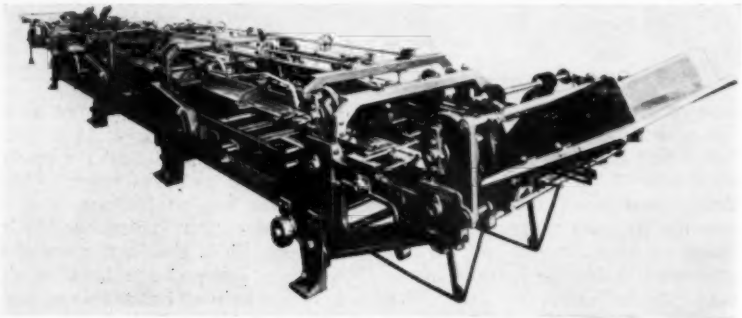
Subject	Inventor or Assignee	Patent No.	Date
Silicate glass adhesive composition	Diamond Alkali Co.	2,850,397	9/2/58
Process of adhering an elastomeric reaction product to metal	Goodyear Tire & Rubber Co.	2,850,424	9/2/58
Remoistenable adhesive	E.I. du Pont de Nemours & Co.	2,850,468	9/2/58

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

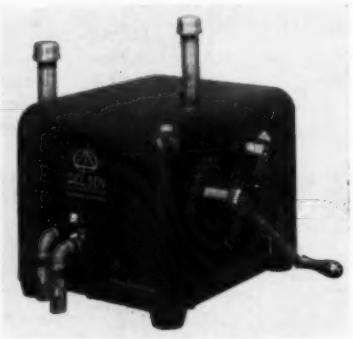
Infold Gluer

The new model of an infold gluer, called the MD Master and used for high speed production of folding cartons, features an increased size range to accept blanks from 4 x 6¾ inches to 28 x 40 inches. The new model also features an adjustable split feed wheel, a 360° adjustment to the upper feed shaft and a 360° adjustment between the main drive and the timing section. These and other improvements, such as standardizing all adjustment screws to fit one crank, are said to make setting up much easier and to reduce the time required from 20 to 25%. Incorporation of anti-backlash gearing, modified side guides, anti-friction bearings and flange couplings contribute toward finer adjustments, more accurate product control, longer wear and less maintenance, according to the manufacturer. *E. G. Staude Manufacturing Co.* E-44



Resin Dispenser

A new variable ratio resin dispenser for use with most two component liquid resin and hardener systems varies the ratio of resin to hardener over a wide range by a simple lever adjustment. Use of the unit allows rapid changeover from one resin-hardener system to another. Changes in resin to hardener ratio can be readily made to compensate for changes in ambient temperature. A reference scale is provided so that ratios may be accurately reset. Provision is made for locking to prevent unintentional changes in the resin to hardener ratio. The unit dispenses a reproducible ratio of resin to hardener, and is equipped with drip-proof outlet valves. The dispenser is available in both hand operated and motor driven models. *Delsen Corp.* E-45

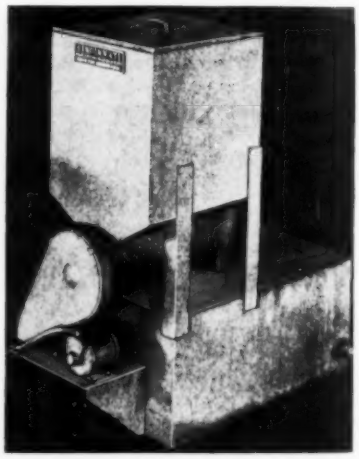


Torch Burner

The Hi-Lo Burner is designed to provide industrial or process heating equipment, such as furnaces, air heaters, ovens and dryers, with an extremely wide range of heat control, yet is inexpensive, requires no adjustments, and features a virtually foolproof design. With low pressure gas, the burner is said to offer a 10 to 1 turndown without flashback or loss of flame stability. With 10 psi gas, the burner provides a 16 to 1 turndown. A stable flame, which is said to be assured throughout the wide heat range, is adjusted automatically when the single control valve changes the gas input. Burner capacities range from 120,000 to 1,800,000 BTU/hr. for the low-pressure series of valves, and from 200,000 to 9,300,000 BTU/hr. for the medium-pressure series. *Bryant Industrial Products Corp.* E-46

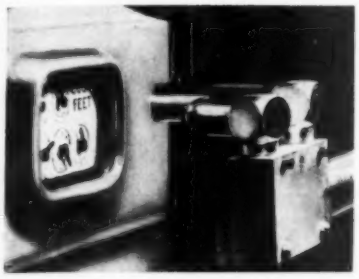
Tank Replenisher

A solution tank replenisher automatically feeds dry chemicals into water, mixing the two as they are introduced into a tank. Simple construction is said to make for foolproof operation, when the controlled solution tank level drops, a float valve actuates a screw conveyor which accurately feeds dry chemicals from a hopper. At the same time, a solenoid valve furnishes fresh water at the rate required for proper solution strength. If the chemicals are readily soluble, mixing occurs without mechanical help; if not, a simple electrical tank agitator can be supplied. Solution strength is said to be easily and accurately variable. Hopper size can provide automatic replenishing over any reasonable length of time, from a work shift to a week or longer. *Cincinnati Cleaning & Finishing Machinery Co.* E-47



Dial Rotation Detector

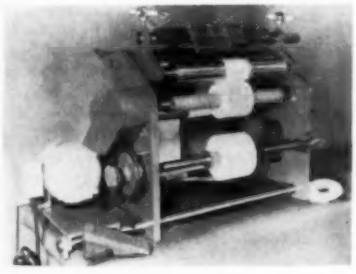
A new unit for dial rotation detection is designed for special monitoring applications. Said to be an extremely sensitive unit, it is pro-



vided with an additional focusing lens for magnification. In operation every revolution of a pointer actuates a signal. Accurate registration is given on a fine line or dot. The unit can also be used for weight control on the production line because the pointer does not pass a specific predetermined point. *ESS Instrument Co.* E-48

Bench Slitter

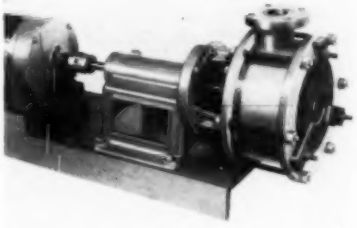
A new bench slitter designed to slit extremely thin material into narrow widths is used on paper, synthetics and tissue. Designated Model BSR-18, it is primarily intended for slitting small parents rolls, on short-run operations requiring a minimum of set-up time, into narrow widths. The slit material is rewound on a



single rewind shaft without interleaving or fusing. The machine rewinds the material on rolls one next to the other across the entire face of the web during the complete operation. The new machine slits as narrow as one-eighth inch with razor blades which can be set within .005-inch tolerance. The slitter operates on a one-half hp three-speed motor that can be plugged into any 110 volt A.C. light socket. Speeds range from 45 fpm to 700 fpm. Various materials as thin as .00025-inch, including Teflon, coated fabrics, polyethylene, coated paper and other products which employ adhesives to bond component layers together, can be slit on the unit. *Appleton Machine Co.* E-49

PVC Centrifugal Pump

A line of centrifugal pumps with all wetted parts of unplasticized, unmodified polyvinyl chloride, said to offer the broadest possible range of chemical resistance as well as the non-contaminating transfer of sensitive solutions, has been announced. Available in four pump sizes, these units offer capacities from 10 to 180 gpm with discharge heads to 100 feet. Solution temperatures to 140°F. can be handled. All the pumps are equipped with mechanical shaft seals of the latest design



which are available in a range of materials to cover virtually all corrosive applications. Pumped fluids contact only the facings of rotating and stationary rings which are also available in a wide range of materials. Unusual simplicity of maintenance is a feature claimed for the line. *Vanton Pump & Equipment Co.* E-50

Drum Handling Attachment

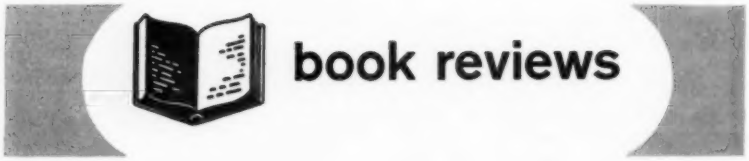
A Liftomatic drum handling attachment for use with electric fork trucks is a mechanical unit designed to engage, transport, place and tier any conventional-type drum without the use of pallets or dunnage. Because the clamping mechanism is adjustable from 35 to 14 inches, any size drum regardless of height, diameter, head or rim size can be handled. The jaws are said to operate perfectly on steel, removable lid, fiber or light gauge (disposable) metal drums either opened or closed. One man can attach the unit to a fork truck in 2 to 3 minutes without the use of tools. *Lewis-Shephard Products, Inc.* E-51

Dust Collector

A new, high efficiency cyclone dust separator, designated Model No. 24, which operates in the 2000 to 3000 cfm range, is specially designed

to handle large volumes of bulky dust. Its self-cleaning radial fan design is said to give high performance at low horsepower requirements. The machine is designed for outside exhaust. When it is desired to save heat and recirculate cleaned air, a model equipped with cloth after-filter bags is available. Other features include a high efficiency long tapering cone design, high inlet velocities and location of the fan on the clean side of the system to eliminate possible fan damage from heavy material being separated. Operated by a 7½-hp motor, the model has a 10-inch inlet and 12-inch outlet. *Torit Manufacturing Co.* E-52

FOR MORE INFORMATION on the new equipment items described here, use the Reader's Service Card elsewhere in this issue.



Automatic Process Control. ***By Donald P. Eckman. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 6 x 9¼ in. 368 pp. $9.00.***

This book presents a study of automatic control, with particular emphasis on process control. Its purpose is to give the beginning engineer—though many other than the engineer can benefit from its contents—the important principles on this branch of industrial science, starting with process analysis and carrying on into the generalized behavior of closed-loop systems. The book is intended primarily for the undergraduate in engineering, and a knowledge of calculus, differential equations, mechanics, thermodynamics and fluid mechanics is necessary for complete comprehension of what the writer has to say.

The author utilizes the techniques of analysis to the fullest, and enough detail is presented so that some of the more difficult problems in automatic process control may be inspected closely. Numerous problems with answers are incorporated into the text, and nine detailed experiments are described.

Automatic process control is used primarily because it results in an economy of operation of industrial processes that more than compensates for the expense of the necessary control equipment. In addition, there are many intangible gains, such as elimination of work not requiring a worthwhile mental effort. Needless to say, it is a topic of vital interest at the present time. The author has prepared a comprehensive text on this subject for the person with a sound knowledge of the sciences and mathematics related to it.

Problems and Practices in Engineering Management. ***(Special Report No. 24). Published by American Management Association, Inc., 1515 Broadway, New York 36, N. Y. 6 x 9 in. 132 pp. $2.50 (members); $3.75 (non-members).***

There is no immediate end in sight to the critical shortage of engineers. Forward-planning companies are taking a new, hard look at the situation, re-examining their existing engineering organizations and applying new management techniques to get more out of their present organization structures. This report is designed to bring management up to date on how best to use its engineers, both in technical capacities and as managers. The papers of which it is comprised were originally presented at a special conference held by the American Management Association's Research and Development Division.

The book is divided into four parts on (1) The Challenge to Management, (2) The Engineering Organization: Its Structure and Functions, (3) Administering the Engineering Program, and (4) Systems Engineering. Three papers are presented on each of these topics. The authors were recruited from the academic world and from some of the largest industrial organizations which utilize engineering personnel. Many of their ideas and observations are thought provoking, and well worth evaluation by administrators who deal with the current engineering personnel market.

Operations Research for Industrial Management. ***By Dimitris N. Chorafas. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 6 x 9¼ in. 304 pp. $8.75.***

A detailed explanation of the most recently developed operations research techniques used for executive decision-making is given in this volume. Emphasis is placed on so-called simulation studies, which arrive at decisions on a mathematical or rational basis rather than by less accurate intuitive methods. The reader is initiated into the fundamentals of this technique through simple examples.

The book includes discussions of the application of operations research methods to such matters as financial allocation, transportation problems, inventory control, and production set-ups. The use of electronic computing in relation to operations research is emphasized. Also analyzed are the most recently developed methods of evaluating alternative courses of action and in making major management decisions.

The material is presented as simply as possible. Those who are not mathematicians can understand the import of the theories discussed. The book, however, contains sufficient description of the details of game theory, linear programming, simulation theory, flow techniques and matrix algebra to be of the greatest interest to systems engineers, computer technologists and other advanced specialists interested in the application of research and analysis to business and industrial problems.

Directory of New England Manufacturers: 1959. ***Published by George D. Hall Co., 20 Kilby St., Boston 9, Mass. 7¾ x 11 in. 788 pp. $45.00.***

The twenty-third annual edition of this directory, which is issued by the publisher with the editorial cooperation of the The New England Council, provides a complete guide to manufacturing in the New England states. The main parts include an alphabetical section of almost 500 pages in which manufacturing companies and relevant information (addresses, personnel, capital ratings, etc.) are listed. Also presented are a products section index and a geographical section. Another part details the companies which make specific products (39 firms are listed as manufacturers of adhesives). The last part of the book is a listing of brand names.

This volume makes a comprehensive survey of manufacturing activities, available products and services in the New England area. It is a valuable handbook for attaining information quickly about companies; about whom to contact in a specific geographical location for a certain product; and for providing a section-wide survey of manufacturing activities by industry. A useful guide to the New England section.

Trade Literature

Bonded Rubber Products. A 12-page publication giving in-use accounts of the application of bonded rubber products. In a section discussing automotive mounting systems, the diagrams and text point up the use of items such as truck transfer case mountings, radiator mountings and tractor hood mountings. The brochure also contains a report on the company's research program and facilities. Emphasis is placed on the potential benefits of pure research, though the significant objective is the establishment of the scientific feasibility of new or improved products or processes. *Lord Mfg. Co.* L-49

Adhesive Formulations. An account of the formulation of structural adhesives by combinations of polyvinyl butyral, polyvinal formal and phenolic resins is given in a 32-page technical manual. Suggested structural formulations are included, and one table lists the adhesive strengths of several. A brief discussion outlines how the quality of a structural bond can be described in terms of its shear strength, peel strength and creep properties. A suggested procedure is offered for the bonding of aluminum alloys. In a separate section, the physical properties of the various resin grades are noted. *Shawinigan Resins Corp.* L-50

Trade Literature

Resilient Roll Glue Spreader. A 12-page bulletin describes a resilient roll glue spreader, designated by its manufacturer as No. 22-D. For use with resins, caseins, polyvinyls, proteins and similar adhesives, the spreader comes in a total of 39 sizes in four models, from 8 through 122-inch capacities in 6-inch increments. Text, photographs and schematic diagrams are used to portray special features of construction and optional equipment. One page is devoted to four smaller sizes of the machine, designated as bench models, and another page is given to a special series for heavy duty operations. A third series for extremely heavy duty, high production, around the clock operation is also described. Among the optional equipment are listed recirculating pump units, V-shaped glue supply tanks, thickness adjustment dial indicator, divided rolls for simultaneous single and double gluing, and others. *Black Brothers Co., Inc.* L-51

Curtain Wall Sealer. A new family of polysulfide-rubber base Weatherban brand sealers is described in a four-page, two-color, illustrated catalog. Eleven case histories tell how these sealers have already performed difficult sealing jobs for a number of various industries including aircraft, automotive, army ordnance, building and gas. The physical properties and performance data of these sealers are listed in chart form along with photographs showing application procedures. *Minnesota Mining and Mfg. Co.* L-52

Remote Reading Liquid Level Gages. An eight-page, three-color catalog covers in detail a complete line of gages for remote liquid level indication for boilers, storage tanks, deaerating vessels, etc. Information on the various styles, models and datum columns simplifies the selection of a unit best suited for a specific industrial requirement. Features of the operation and application of units and their accessories are explained in detail. *Jerguson Gage & Valve Co.* L-53

Roller Chains and Sprockets. A handsomely illustrated 154-page catalog is devoted to a complete line of roller chains for various types of mechanical equipment. Schematic drawings provide easily understandable explanations of preferred drive arrangements and various engineering recommendations. Complete sets of tables and specifications on the different types of drive chains and sprockets are included. The booklet contains a special section of layouts and formulas for conveyor engineering. *Link-Belt Co.* L-54

Adipic Acid. The molecular structure, physical and chemical properties of adipic acid are given in a 36-page booklet. Suggested uses are described at length. For adhesives these include improvement in adhesion of rubber-to-tire fabrics; use in an adhesive composition employed in the manufacture of a pile fabric; and applications as additives to various glues, and as an anti-gelling agent for adhesive compositions. Resins from an adipic acid-glycerol resin are employed in adhesives for plywood and for bonding the abrasives in grinding wheels and sandpaper, and a condensation polymer from glycol, adipic acid and 2,4-toluenediamine is used as an adhesive for metals, glasses and leathers. A bibliography of 271 references and a subject index close the publication. *National Aniline Division, Allied Chemical & Dye Corp.* L-55

Testing Service. The complete line of laboratory and field testing facilities and services available from a large independent laboratory is presented in a six-page bulletin. Included is a complete description of the company's engineering facilities, and how the customer can use them in researching his problems. Other services described relate to an organic and inorganic chemical laboratory, materials testing, engineering inspection, textile laboratory, package testing facilities, microbiology, microscopy, psychometrics and certification of product quality. The facility is equipped to handle all types of problems connected with adhesives. *United States Testing Co.* L-56

Silicones and Adhesives. An up-to-date reference guide, a 16-page booklet is heavily illustrated and features an expanded indexing system to facilitate quick and easy location of the more than 150 silicone products now commercially available. The features and uses of tapes based on silicone adhesives are discussed. In addition, a complete rundown of the company's five laminating resins is given. The publication includes a table of the typical properties of silicone-glass laminates. Under the heading "Molding Compounds" is a brief discussion of the features and uses of structural and electrical parts made from silicone resins. *Dow Corning Corp.* L-57

FOR MORE INFORMATION on the trade literature reviewed here, use the Reader's Service Card elsewhere in this issue.

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in passing

Adhesives Technology

► We are all aware of the rapidity with which adhesives technology is moving. Every passing month finds adhesives receiving increased attention in both old and new quarters. Within recent months special attention has been paid to adhesives in the form of symposiums by both the Chemical Market Research Association and the Chemical Commercial Development Association. Now we learn that two plastics groups—the Society of Plastics Engineers and the Society of the Plastics Industry—will devote special sessions to adhesives at their respective annual meetings to be held within the next few weeks. The SPE session, to be held in New York on January 29, will cover such subjects as the chemistry of cyanoacrylate adhesives, developments in 100% solids epoxy resin-based adhesives, new hot melt adhesives and latest developments in elastomeric adhesives. The SPI session, to be held in Chicago on February 3, will hear talks on types of bonds involved in adhesion, adhesive bonding of reinforced plastics, mechanism of adhesion, and stress concentration effects on reinforced plastic laminates. Some valuable new data will be presented at both of these meetings. Some of the papers will be showing up in this journal. Watch for them.

Public Recognition

► The adhesives industry has arrived! It has finally achieved full public recognition. Well, almost. A recent issue of the *New York World Telegram* carried a story under the head of "Adhesives Now Keep Much of Our Industry Together." The story made mention of the fact that the present era has been given many names, most of them starting with the letter A. Among them: The Atomic Age, The Automation Age, The Advertising Age. Now, says the alert reporter, there is another candidate: The Adhesive Age. As proof, the story points out that so many things all around us that used to be put together with nails, rivets and screws are now being put together with new materials that in many cases form a bond stronger than the objects they hold together. This is not news to the adhesives industry, but we are reasonably sure it was news to thousands of the readers of the New York newspaper. Believe us, the reference to The Adhesive Age and the name of this journal is purely coincidental.

New Idea

► Every issue of *Popular Science* carries one or more pages devoted to "I'd Like to See Them Make . . ." The suggestions offered by the readers of this practical monthly in these pages are often intriguing and frequently make good sense. One that caught our eye recently concerned lead-in television wires. It was suggested that pressure-sensitive adhesive be applied to the lead-in wire so that it would anchor the wire fast from the antenna down the side of the house, along the joist, floor or baseboard. Sounds like an opportunity for some quick-thinking adhesive manufacturer to sell a bill of goods to some progressive lead-in wire manufacturer.

Wondrous Days

► Can you picture an economy in which the majority of families have four cars? Can you imagine a law on the books which makes it illegal to keep a car longer than fifteen months? Can you picture the time when the age limit for driving licenses is 12 years? Well, Douglass Wallop can and does in his new book on "What Has Four Wheels and Flies." (W. W. Norton & Co., New York, $2.95.) Mr. Wallop goes much further. He talks about automobiles with television, telephones and air conditioning as standard equipment. About cars with back-seat kitchens, with everything working by push-button, including acceleration and braking. All of this takes place some time in that wonderful world after 1965. Detroit has so thoroughly saturated the market that stockholders are in complete despair. A good portion of Mr. Wallop's novel is concerned with some fanciful thinking about dogs which drive the so-easy-to-handle automobiles. This enables him to dwell at length on man's inhumanity to man on the highways. But it makes for some interesting reading and lets the mind wander off into the future. Should all this come to pass, imagine the market for automotive adhesives. Wow!

Short Story

► The following appeared in a recent issue of the Wall Street Journal: The United States Government is estimated to have given away more than $60 billion in foreign aid since World War II. Now then, Virginia, what was your question?